CIVIL ENGINEERING

Published by the American Society of Civil Engineers

APRIL 1946

RING
RY

APR 12 1946

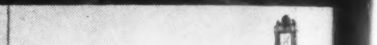
AMERICAN
SOCIETY OF
CIVIL
ENGINEERS
FOUNDED
1852

Laying Pipe for
Salt Lake Aqueduct, Utah

COMPLETE SERVICE

When you call in the Raymond organization, you will find a wealth of experience at your command from the preliminary investigation of underground conditions to the complete installation of the foundation. During the past 49 years Raymond has been building up a huge backlog of "know-how" on every recognized type of pile foundation—concrete, composite, precast, steel, pipe and wood. Also caissons, construction involving shore protection, ship building facilities, harbor & river improvements, borings for soil investigation. We are at your service.

★ ★ ★ ★ ★ ★



★ ★ ★ **RAYMOND** **CONCRETE PILE CO**

Branch Offices in Principal Cities of United States & Latin Amer

140 CEDAR STREET, NEW YORK 6, N.

Among Our Writers

LESLIE WILLIAMS (Harvard U., Master in City Planning) held a research fellowship in traffic engineering at Harvard's Graduate School of Engineering and later taught in Yale's Highway Traffic Bureau. He served as director of the Civic Planning and Traffic Board of Providence, and was engineer-director of the Governor's Commission on Metropolitan-Transportation in Rhode Island. He is now City Planning Engr. of the Amer. Transit Assoc.

W. S. CHAPIN (Northeastern U. '27) was for 7 years Liaison Engr. between the State and City of New York on a large parkway mileage, then consulting engr. for the War Dept. on transportation facilities for the Pentagon Bldg. During the war he became a lieutenant colonel, Corps of Engrs. He is now consultant for the Triborough Bridge and N. Y. City Tunnel authorities, and the Pittsburgh Regional Planning Assoc. He represents the N.Y. City Construction Coordinator in matters relating to arterial highways.

D. ALLAN FIRMAGE (U. of Utah, B.S. in C.E. '40; M.I.T., M.S. in C.E. '41) was an aircraft stress analyst with the E. G. Budd Manufacturing Co. following graduation. In 1942 he joined the staff of the Engineer Board at Fort Belvoir, Va., as Asst. Engr., but soon became an Associate Engr., and in 1945, Engineer. His work has consisted of analyzing, designing, developing, and testing portable bridging equipment for the U.S. Army.

ROBERT N. CLARK (Syracuse U., C.E. '25, M.S. '26) has had a variety of engineering experience, including sales promotion and design and construction of water and sewage treatment plants. Since 1937 he has been District Sanitary Engr. with the N.Y. State Dept. of Health, except for 4 years on military leave, when he was with the First and Ninth Service Commands, U.S. Army, in charge of the sanitary inspection work of the Medical Dept.

L. R. Dunkley (U. of Utah) left the university to enlist in the Navy in World War I. After sea duty he was appointed to a U.S. engineering school. He has worked on preliminary investigations for five of the Bureau of Reclamation's seven constructed projects in Utah. Since 1938 he has been one of the top-ranking engineers on the Provo River Project, and was recently advanced from Resident Engr. to Construction Engr.

WALLIS S. HAMILTON (Carnegie Inst. of Tech., '35, M.S. in C.E. '39; U. of Iowa, Ph.D. in Mechanics and Hydraulics '43) before receiving his Ph.D. worked for the TVA, for the U.S.G.S., and for Prof. H. A. Thomas at Carnegie Tech. on hydraulic models. Then for 3 years he taught mechanics and hydraulics at Carnegie Tech. Since 1943 he has taught at Northwestern U. and is now Asst. Prof. in the Civil Engineering Dept.

ADOLF A. MEYER (Swiss Inst. of Tech., Zürich, C.E. '19) has been connected with design and construction of hydroëlectric power developments since 1922. After 8 years with the Safe Harbor Water Power Corp., he joined the TVA in 1936. Since 1939 he has been Chief of the Civil Design Division.

MARTIN GROSS (Columbia U., C.E.) was construction supt. for H. R. H. Construction Corp. in New York, then chief engr. on the Castle Village Housing Project. In the Army he rose to Master Sergeant, and soon after the Engineers reached the Philippines was transferred to the Luzon Engr. Dist., which did most of the rehabilitation work there. Commissioned in the field, he was awarded the Bronze Star Medal for meritorious service. He is now starting a construction business in Newark, N.J.

R. W. FINKE (U. of Wash., B.S. '26) spent 5 years as structural detailer and draftsman with several engineering firms before joining the engineering staff of the State of Washington, Dept. of Highways, in 1931. Starting as a bridge designer, he has been successively Designing Engr., Acting Bridge Engr., Asst. Bridge Engr., and finally Bridge Engr., which latter position he has held for the past 7 years.

VOLUME 16 NUMBER 4

April 1946

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

COPYRIGHT, 1946, BY THE
AMERICAN SOCIETY OF CIVIL ENGINEERS
Printed in U. S. A.

Entered as second-class matter September 23, 1930, at the Post Office at Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at special rate of postage provided for in Section 1102, Act of October 3, 1917, authorized on July 5, 1918.

CIVIL ENGINEERING

Published Monthly by the
AMERICAN SOCIETY OF CIVIL ENGINEERS
(Founded November 5, 1852)

PUBLICATION OFFICE: 20TH AND NORTHAMPTON STREETS, EASTON, PA.
EDITORIAL AND ADVERTISING DEPARTMENTS:
33 WEST 39TH STREET, NEW YORK 18

This Issue Contains

COVER—Laying Pipe for Salt Lake Aqueduct, Utah (*see article, page 160*)

PROGRAM FOR SPRING MEETING IN PHILADELPHIA . . . 145

WHAT CAN BE DONE ABOUT TRAFFIC CONGESTION?

I. The Problem We Face . . . 149
Leslie Williams

II. Urban Parkways and Expressways . . . 151
W. S. Chapin

TESTING BAILEY BRIDGES TO FAILURE . . . 154
D. Allan Firmage

THE CASE FOR BREAK-POINT CHLORINATION . . . 157
Robert N. Clark

AQUEDUCT FOR SALT LAKE CITY . . . 160
L. R. Dunkley

AIMS OF A CURRICULUM FOR CIVIL ENGINEERING GRADUATES . . . 163
Wallis S. Hamilton

SPILLWAY DESIGNED FOR LONG-RANGE SAVINGS . . . 165
Adolf A. Meyer

RECONSTRUCTION OF MANILA HARBOR . . . 168
Martin M. Gross

SINGLE-COLUMN VIADUCT ELIMINATES NEED FOR SKEW SPANS . . . 172
R. W. Finke

ENGINEERS' NOTEBOOK

"Common Well" Nomograph . . . 175
Ira J. Hooks and *Hamilton Gray*

A Device for Classroom Demonstration of Moving Loads . . . 176
D. D. Haines

OUR READERS SAY . . . 177

SOCIETY AFFAIRS . . . 179

ITEMS OF INTEREST . . . 187

NEWS OF ENGINEERS . . . 191

DECEASED . . . 192

CHANGES IN MEMBERSHIP GRADES . . . 16, 18

APPLICATIONS FOR ADMISSION AND TRANSFER . . . 20, 22, 24

RECENT BOOKS . . . 24

ENGINEERING SOCIETIES' PERSONNEL SERVICE, INC. . . . 26, 28

CURRENT PERIODICAL LITERATURE . . . 28, 30, 32, 34

CATALOG DIGEST . . . 36, 38, 40, 42, 43, 44, 45, 46, 47, 48, 50

INDEX TO ADVERTISERS . . . 56

The Society is not responsible for any statements made or opinions expressed in its publications.

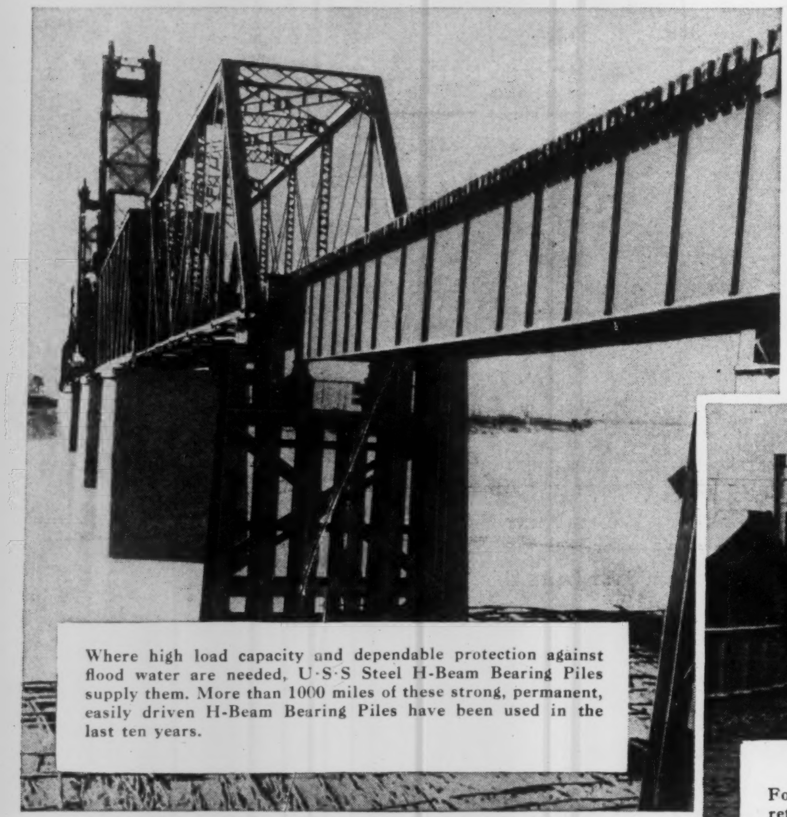
Reprints from this publication may be made on condition that full credit be given CIVIL ENGINEERING *and the author, and that date of publication be stated.*

SUBSCRIPTION RATES

Price 50 cents a copy; $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents and foreign postage $1.50 additional.

Member Audit Bureau of Circulations

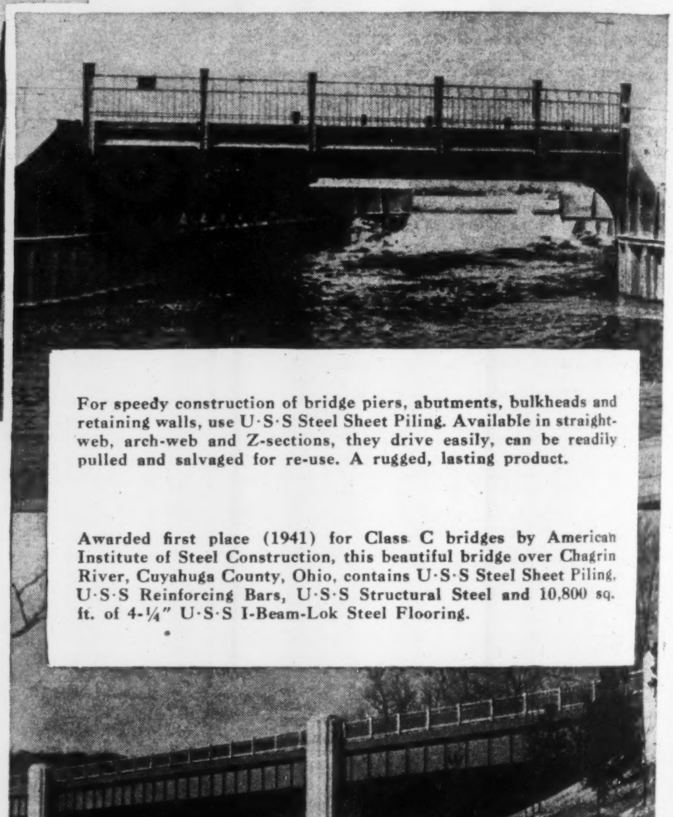
To build better bridges... *build with Steel!*



Where high load capacity and dependable protection against flood water are needed, U·S·S Steel H-Beam Bearing Piles supply them. More than 1000 miles of these strong, permanent, easily driven H-Beam Bearing Piles have been used in the last ten years.

Only *Steel* Can Give You All Of These Six Structural Advantages:

- ★ High Strength-Weight Ratio
- ★ Highest Modulus of Elasticity
- ★ Extra Toughness and Shock Resistance
- ★ Versatility of Application
- ★ Great Durability
- ★ Ultimate Economy



For speedy construction of bridge piers, abutments, bulkheads and retaining walls, use U·S·S Steel Sheet Piling. Available in straight-web, arch-web and Z-sections, they drive easily, can be readily pulled and salvaged for re-use. A rugged, lasting product.

Awarded first place (1941) for Class C bridges by American Institute of Steel Construction, this beautiful bridge over Chagrin River, Cuyahuga County, Ohio, contains U·S·S Steel Sheet Piling, U·S·S Reinforcing Bars, U·S·S Structural Steel and 10,800 sq. ft. of 4-¼" U·S·S I-Beam-Lok Steel Flooring.

ONE of the most impressive lessons learned from the war is that you don't need a lot of time to turn out a first class job.

For instance, consider the construction miracle that made possible the atomic bomb—a three billion dollar venture that involved the erection of stupendous and intricate plants, complete new towns, many miles of streets, highways and heavy-duty bridges.

Prefabricated, easier-to-handle steel—such as piling, concrete reinforcing bars, bridge flooring and culverts—played an important role in the speedy, sound and safe construction of practically all of these highly important projects . . . just as it will help you establish time and money saving records on the many peacetime jobs coming up.

An inquiry will promptly bring descriptive literature on the U·S·S Engineering Products listed in the column at the right. Just address the office nearest you.

U·S·S ENGINEERING PRODUCTS

- U·S·S Sheet Steel Piling
- U·S·S H-Beam Bearing Piles
- U·S·S I-Beam-Lok Steel Flooring
- U·S·S Multigrip Floor Plate
- U·S·S Concrete Reinforcing Bars

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

Tennessee Coal, Iron & Railroad Company, Birmingham, *Southern Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL

Philadelphia Host to Spring Meeting

Conference and Technical Sessions, April 17–19

FOR the first time since 1942, a Spring Meeting of the American Society of Civil Engineers is scheduled. Host to the visiting engineers, expected to number well over a thousand, will be the city of Philadelphia. Here during the third week in April—the 17th, 18th and 19th—will be presented a most interesting program arranged by the Philadelphia Section.

APPROACH TO DELAWARE RIVER BRIDGE, PHILADELPHIA

Both professional and technical sessions are planned. The Society's only member in Congress, the Hon. Carl Hinshaw of Pasadena, Calif., will address the gathering. He is going to discuss the opportunities and obligations of "The Engineer in Public Life." Prior to his election to Congress he was very active in the development of many important projects in California, best known of which was the Arroyo Seco Highway, which he actively promoted while president of the Pasadena Realty Board.

Welcome to the city will be extended by Mayor Bernard Samuel, speaking at the opening session. ASCE President W. W. Horner will respond and introduce Edward Hopkinson, Jr., Chairman of the Philadelphia Planning Commission, who will discuss plans of Philadelphia for the development of its traffic arteries, recreational areas, zoning, and related matters.

TECHNICAL SESSIONS

Eight Technical Divisions of the Society will hold meetings in Philadelphia. A detailed schedule of subjects, speakers, and times is contained in the complete meeting program that follows. All these technical sessions will be held in the Hotel Bellevue Stratford, the Meeting Headquarters. The hotel staff has made extensive arrangements to accommodate all those who attend the meeting, and special efforts are being made to provide as many rooms as needed for overnight guests.

To better acquaint visitors with the city, two excursions will be made to points of special interest. These have been so arranged that both engineering and cultural inclinations will be served. One trip will visit the great Philadelphia Naval Base, where famous aircraft carriers and battleships will be hosts to the visitors. Other facilities of unusual nature will be inspected under the guidance of Naval officers. This party will then travel to a new power generating station and to several other especially important points.

A second excursion has been arranged to acquaint visitors with several places that have become a part of the historic culture of our nation. The Independence Hall and all the inspiring memorials of the early days of America's developing national character are on the itinerary. Later the cavalcade will be driven through Valley Forge, pausing at the beautiful Memorial Chapel there.

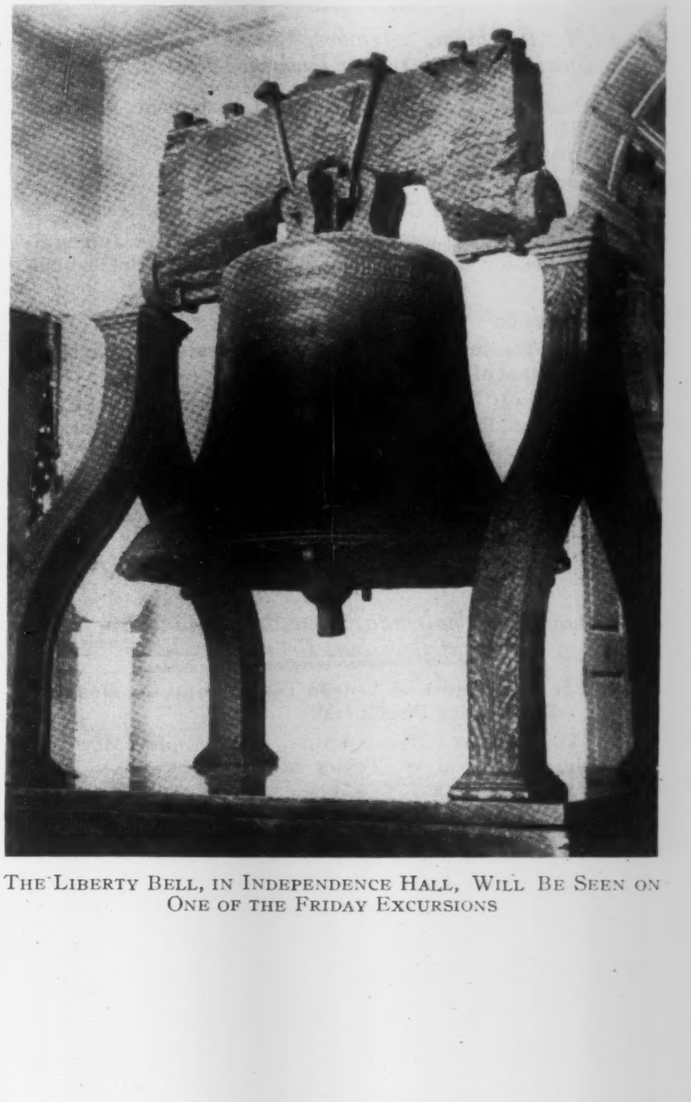
Entertainment and social gatherings in abundance have been scheduled, so that delegates can find ample opportunity to meet and visit with colleagues. For the ladies who may accompany their engineers, there will be teas and trips and gatherings of more informal nature. And of course all will want to attend the fine dinner and social evening which the meeting committee has planned for all guests to the "City of Brotherly Love."

CONFERENCES SCHEDULED

In serious consideration of the professional activities of ASCE, two conferences will be held in Philadelphia. A Student Chapter Conference will gather to delve into problems facing the Society in serving the students who have the future of engineering in their keeping. Also a Local Section Conference is scheduled.

Many members still recall with pleasure the last meeting held in Philadelphia way back in 1926. In more recent years the Philadelphia Section arranged a grand meeting held at Atlantic City, in 1932. Such recollections are most pleasant indeed and have set a high standard for such meetings. This year the Philadelphians have set out to surpass all their previous efforts.

A large committee, headed by Francis S. Friel, president of the Philadelphia Section, has been diligently at work in making the required arrangements.



THE LIBERTY BELL, IN INDEPENDENCE HALL, WILL BE SEEN ON ONE OF THE FRIDAY EXCURSIONS

Spring Meeting in Philadelphia, Pa.

Hotel Bellevue Stratford to Be Headquarters, April 17–19, 1946

General Meeting—Wednesday Morning

9:00 **Registration in Roof Lobby**

ROSE GARDEN

10:00 **Spring Meeting called to order by**

FRANCIS S. FRIEL, M. ASCE, President, Philadelphia, Section, ASCE

10:10 **Address of Welcome**

HON. BERNARD SAMUEL, Mayor of the City of Philadelphia

10:30 **Response**

W. W. HORNER, President, American Society of Civil Engineers

11:00 **Address—Plans for Philadelphia of Particular Interest to Civil Engineers**

EDWARD HOPKINSON, JR., Chairman, Philadelphia City Planning Commission

11:45 **Recess**

12:15 **Luncheon—Clover and Red Rooms**

Ladies are cordially invited to attend the Luncheon.

Tickets, $2.00 each for Members, Ladies, and Guests. No charge for Student tickets.

At the close of the Luncheon there will be an address by the HON. CARL HINSHAW, Pasadena, Calif., Assoc. M. ASCE, Member of Congress, House of Representatives, Washington, D.C., entitled **"The Engineer in Public Life"**

Sessions of Technical Divisions—Wednesday Afternoon

Sanitary Engineering Division

ROSE GARDEN

Harry M. Freeburn, Member, Executive Committee, Sanitary Engineering Division, Presiding

2:00 **"Pennsylvania Stream Pollution Abatement Program"**

H. E. MOSES, M. ASCE, Chief Engineer, State Department of Health, Harrisburg, Pa.

2:40 **Discussion**

2:50 **"Schuylkill River Culm Elimination Program"**

JAMES H. ALLEN, M. ASCE, Chief Engineer, Interstate Commission on the Delaware River Basin, Philadelphia, Pa.

3:30 **Discussion**

3:40 **"The Treatment of Water to Inactivate the Causative Agent of Infectious Hepatites"**

JAMES B. BATY, Major, Sanitary Corps, U.S.A., Chief, Sanitary Engineering Branch, Office of the Surgeon General, Washington, D.C.

4:20 **Discussion**

Structural Division

NORTH GARDEN

Alfred Hedefine, Chairman, Executive Committee, Structural Division, Presiding

2:00 **"The Significance of Tensile Test Data in the Design of Engineering Structures"**

DR. DWIGHT F. WINDENBURG, Head, Applied Mechanics Division, David W. Taylor Model Basin, Navy Dept., Washington, D.C.

2:35 **Discussion**

3:00 **"The Construction of the Pecos River Bridge"**

E. L. DURKEE, M. ASCE, Engineer of Erection, Bethlehem Steel Company, Bethlehem, Pa.

Highway Division

SOUTH GARDEN

Day Okes, Chairman, Executive Committee, Highway Division, Presiding

2:00 **"Highway Research Developments and Future Programs"**

ROY W. CRUM, M. ASCE, Director, Highway Research Board, Washington, D.C.

2:40 **"State-City Program of Highway Improvements in Philadelphia"**

JOHN L. HELBER, Chief Engineer, Department of Highways, Harrisburg, Pa.

3:20 **"State Highway Approaches to Metropolitan Areas"**

CHARLES M. NOBLE, M. ASCE, State Highway Engineer, New Jersey State Highway Department, Trenton, N.J.

Trip for Ladies

Wednesday Afternoon

Buses will leave the Bellevue Stratford Hotel at 2:15 p.m. to take the ladies to the Fels Planetarium, where they will enjoy the thrill of a "Trip to the Moon" in a space ship. The Fels Planetarium is one of the outstanding institutions of its kind in the country. After returning from the moon, the ladies will have an opportunity for a glimpse of the many interesting historical and scientific exhibits in beautiful Franklin Institute. Buses will return the party to the Bellevue Stratford Hotel.

The price per person, including admission to the Fels Planetarium, will be 50 cents.

Dinner, Entertainment, and Dance—Wednesday Evening

Ball Room

6:30 **Assembly**
Cocktails
7:00 **Dinner**
8:30 **Floor Show**
10:00 **Dancing**

The seating list for the Dinner will close at 6:00 p.m., Tuesday, April 16, 1946. Members purchasing tickets after that hour will be assigned tables in order of purchase. Tickets will be on sale at the Registration Desk until 5:00 p.m., Wednesday April 17.

Dinner will be served promptly at 7:00. Arrangements have been made for tables seating 8 persons.

Tickets $5.50 each for members, Ladies, and Guests.
Juniors, $2.00 per couple for Entertainment and Dance only.
No charge for Students for Entertainment and Dance only.

Technical Division Sessions—All Day Thursday

Thursday Morning

Power Division

South Garden

A. T. Larned, Chairman, Executive Committee, Power Division, Presiding

9:00 **"Ice-Troubles at Hydroelectric Plants"**
Paul E. Gisiger, M. ASCE, Structural Engineer, Pennsylvania Water and Power Co. and Safe Harbor Water and Power Corp., Baltimore, Md.

9:30 **Discussion**

9:45 **"Coordination of Hydro Power with Steam Power in a Major Power System"**
Robert E. Turner, M. ASCE, Hydrographer, The Susquehanna Electric Co., Conowingo, Md.

10:15 **Discussion**

10:30 **General discussion**

Benjamin Franklin Parkway from City Hall, Philadelphia

Soil Mechanics and Foundations Division

North Garden

Frank A. Marston, Chairman, Executive Committee, Soil Mechanics and Foundations Division, Presiding

9:30 **Introductory Remarks**
Frank A. Marston, M. ASCE, Consulting Engineer Boston, Mass.

SUBDRAINAGE OF AIRFIELDS—SYMPOSIUM

Program arranged by the Committee on Airfield Foundations, under the auspices of the Soil Mechanics and Foundations Division

9:40 **"Theoretical Analysis of Drainage of Base Courses"**
Arthur Casagrande, M. ASCE, Associate Professor of Civil Engineering, Graduate School of Engineering, Harvard University, Cambridge, Mass.

Discussion by
G. W. McAlpin, Assoc. M. ASCE, Associate Soils Engineer, Department of Public Works, Albany, N.Y.

10:10 **"Model Investigations of Drainage of Base Courses"**
William L. Shannon, Jun. ASCE, Engineer, U.S. Engineer's Office, Boston, Mass.

10:40 **Discussion by**
Howard M. Williams, Office of Chief of Engineers, U.S.A., Washington, D.C.
Carl F. Izzard, Assoc. M. ASCE, Highway Engineer Public Roads Administration, Washington, D.C.

Sanitary Engineering Division

Rose Garden

Harry M. Freeburn, Member, Executive Committee, Sanitary Engineering Division, Presiding

9:00 **"U.S. Sanitary Corps. Problem in World War II"**
W. A. Hardenbergh, M. ASCE, Editor "Public Works," New York, N.Y.

9:40 **Discussion**

9:50 **"The Collection and Disposal of Refuse in Lower Merion Township, Pennsylvania"**
Walter E. Rosengarten, M. ASCE, Township Engineer, Ardmore, Pa.

10:30 **Discussion**

10:40 **"The Quality of Water and Its Value for Industrial and Domestic Uses"**
Sheppard T. Powell, Consulting Chemical Engineer Baltimore, Md.

11:20 **Discussion**

Thursday Afternoon

Construction Division

ROSE GARDEN

Admiral Kirby Smith, Chairman, Executive Committee, Construction Division, Presiding

2:00 **"Opportunities for Veterans in the Construction Industry"**
DAY OKES, Assoc. M. ASCE, Partner, Okes Construction Company, St. Paul, Minn.

2:20 **"Economic Trends in the Construction Industry"**
DONALD D. KING, Assoc. M. ASCE, King Advertising Services, New York, N.Y.

2:50 **"Construction Equipment in World War II"**
LOU R. CRANDALL, President, George A. Fuller Co., New York, N.Y.

Following the paper there will be a movie on construction operations in the Western Pacific

3:50 **General discussion**

Surveying and Mapping Division

SOUTH GARDEN

Philip Kissam, Chairman, Executive Division, Surveying and Mapping Division, Presiding

2:00 **"The Use of Plane Coordinates in Engineering Surveys"**
B. EVERETT BEAVIN, Assoc. M. ASCE, Project Engineer, J. E. Greiner Co., Annapolis, Md.

2:35 **Discussion by**
CARROLL F. MERRIAM, Engineer, Pennsylvania Water and Power Co., Baltimore, Md.

2:45 **"Comparison between Surveying Methods of the United States and Continental European Countries"**
DAVID L. MILLS, Engineer, Army Map Service, Washington, D.C.

3:15 **Discussion by**
MAJ. FLOYD W. HOUGH, M. ASCE, Chief Geodetic Division, Army Map Service, Washington, D.C.

3:25 **"Army Survey Equipment"**
W. S. LITTLE, Assoc. M. ASCE, Major, Corps of Engineers, U.S.A. Engineer Board, Fort Belvoir, Va.

Waterways Division

NORTH GARDEN

Col. C. L. Hall, Chairman, Executive Division, Waterways Division, Presiding

2:00 **"Delaware River Improvements for Navigation"**
L. D. SHUMAN, Head Engineer, U.S. Engineer Dept., Philadelphia District Office, Corps of Engineers, U.S.A.

2:30 **Discussion by**
H. A. WHITCOMB, Assoc. M. ASCE, Senior Civil Engineer, U.S. Engineer's Office, Providence, R.I.

2:40 **"Delware River Flood Control Problems"**
C. F. WICKER, Assoc. M. ASCE, Chief, Engineering Division, U.S. Engineer Dept., Philadelphia District Office, Corps of Engineers, U.S.A.

3:10 **Discussion by**
C. K. PANISH, Assoc. M. ASCE, Lt. Col., Corps of Engineers, U.S.A., U.S. Engineer Office, New York, N.Y.

Thursday Afternoon Tea for Ladies

An important function for the ladies will be a tea in the Burgundy Room of the Bellevue Stratford on Thursday afternoon, April 18. Tea will be preceded at 2:30 by a highly original and delightful one-woman program presented by Florence Fraser Ludgate. Her "Pen and Piano Portraits" are charming and authentic. In four of these Portraits, she will tell of various composers and their associates, playing the music to set off their characteristics. A pianist of considerable ability, Mrs. Ludgate has the rare gift of recreating the atmosphere of an era, and her skill in characterization is marked.

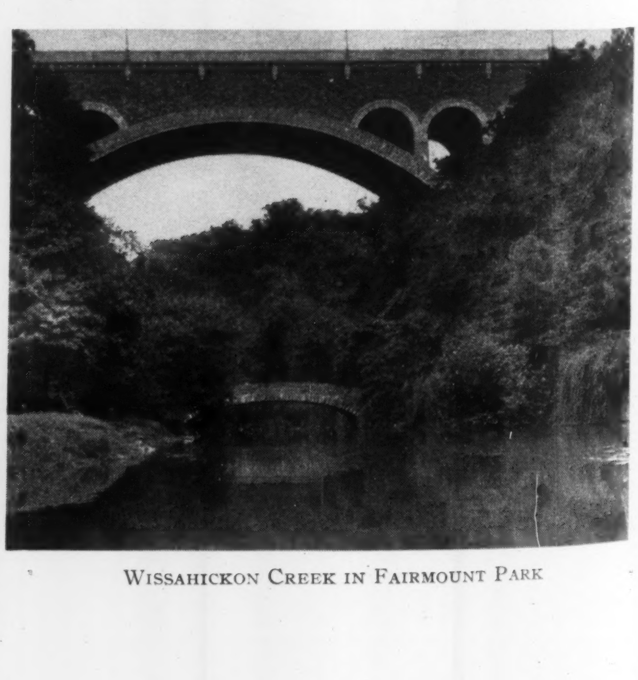
The Portraits to be presented are:

"Dr. Burney Entertains"
"Dearest Johannes"
"The Story of Stephen Foster"
"A Gift for Ludmilla"

Mrs. Ludgate is a graduate of the American Conservatory in Fontainbleau, France, and holds a degree in music from the Curtis Institute.

Tickets for the Portraits and tea will be $1.50 per person.

INDEPENDENCE HALL AND COMMODORE BARRY MONUMENT



WISSAHICKON CREEK IN FAIRMOUNT PARK

Two All-Day Excursions on Friday

EXCURSION TO PLACES OF HISTORIC INTEREST

The party will leave the Bellevue Stratford Hotel at 9:30 a.m. by bus to Independence Square, from which the nearby places of historic interest will be visited. These include Independence Hall, which contains the Liberty Bell and the room in which the Declaration of Independence was signed; Congress Hall where Presidents Washington and Adams were inaugurated; and the Court House occupied by the U.S. Supreme Court from 1797 to 1800. Other places of interest to be visited will be Carpenters Hall, where the first Continental Congress assembled in 1774; the grave of Benjamin Franklin; the first Friends' Meeting House; the Betsy Ross House, where the first flag adopted by the United States was made; and Christ Church, attended by George Washington and other men prominent in colonial life.

From Independence Hall, the party will proceed to the Bala Country Club for luncheon.

Following the luncheon, the group will go to Valley Forge. At this historic spot, where Washington's troops spent the Winter of 1777–1778, are located Washington's headquarters, the original trenches, and other features of the encampment. Of particular interest is the beautiful Memorial Chapel, which will be inspected with the aid of guides.

The party will return by bus to the Bellevue Stratford Hotel by late afternoon. Members and their wives are cordially invited to participate in this trip. The price per person, including the luncheon, is $2.50.

EXCURSION TO PLACES OF ENGINEERING INTEREST

The party will leave the Bellevue Stratford Hotel at 9:00 a.m. by bus to the Philadelphia Naval Base for a tour of the Navy Yard and the Air Materials Center, where some of the famous aircraft carriers and battleships, drydocks, the air experimental laboratory, airplane hangars of the concrete arch construction type, and many other war facilities of engineering interest will be inspected.

From the Navy Yard, the party will travel to the Southwark Station of the Philadelphia Electric Company, where an inspection of this plant will be made. The Southwark Station is a new generating plant now being constructed by the Philadelphia Electric Company. It has two 169,000-kw units. Representatives of the power company will describe the structural, mechanical, and electrical phases of the design.

From the Southwark Station, the party will proceed to the Bala Country Club for luncheon. Following luncheon, the group will go to the Franklin Institute for an inspection of many historic and scientific exhibits of engineering importance. The party will tour this new modern building, with its numerous exhibits in the scientific field. One of the outstanding features is the Fels Planetarium, where it will be possible to view a miniature of the heavens as they would be on this Good Friday.

The party will return by bus to the Bellevue Stratford Hotel by late afternoon. Members and their wives are cordially invited to participate in this trip. The price per person, including the luncheon, will be $2.50.

Hotel Accommodations and Announcements

Hotel Accommodations

The Bellevue Stratford Hotel is Meeting Headquarters and a block of rooms has been set aside for the accommodation of members. The rates range from $7 to $9 for double rooms and from $4.50 to $6 for single rooms.

Requests for reservations should be made directly with the Bellevue Stratford as far in advance of the meeting as possible, **stating that the reservation is for attendance at the ASCE Spring Meeting.**

In case the hotel is unable to fill a request because of lack of rooms, attempt will be made to fill the request at nearby hotels.

Requests for reservations at prices other than those quoted above will be made at other nearby hotels.

Confirmation of hotel reservations will be made direct by the hotel.

Information

An information desk will be provided in the Headquarters Hotel to assist visiting members in securing desired information about the city. At the registration desk a card file of those in attendance will be maintained, with information as to Philadelphia addresses.

Efforts will be made to deliver telegrams and messages promptly. Any mail for members received at Headquarters during the meeting will be delivered to the hotel address, if known; otherwise it will be held at the Information Desk. Letters undelivered at the close of the meeting will be forwarded to the latest mailing address

Entertainment for the Ladies

Attention is directed to the entertainment provided for the ladies. It is expected that they will participate with the members in any other features of the program in which they are interested.

Local Sections Conference, Monday and Tuesday, April 15 and 16, 1946

A conference of representatives of Local Sections will meet at 10:00 a.m. on Monday and Tuesday, April 15 and 16, 1946, at the Bellevue Stratford. The program will schedule topics of professional rather than technical interest, in which all representatives are expected to participate. All members of the Society are welcome to attend.

Student Conference

TUESDAY, APRIL 16

9:00 **Registration—Hotel Bellevue Stratford**

9:45 **Conference Opens in Red Room**

Gerald E. Nolin, A/S, U.S.N.R., President of Swarthmore Student Chapter, Presiding

Address of Welcome

R. A. Marr, Jr., M. ASCE, Chairman, Committee on Student Chapters

10:00 **The Engineer and Labor Organizations**

E. L. Chandler, M. ASCE, Washington, D.C., Representative of the Society

11:00 **The Engineer in Public Affairs**

George E. Barnes, M. ASCE, Head, Department of Civil Engineering and Professor of Hydraulic and Sanitary Engineering, Case School of Applied Science, Cleveland, Ohio.

12:00 **Recess**

12:15 **Luncheon—Engineer's Club, 1317 Spruce Street**

Student Tickets, $.50 each

2:00 **Inspection Trip to Naval Base**

Following the luncheon, Students will go by bus for an inspection of the Philadelphia Naval Base. This base has many facilities of interest to engineering students, such as shops, laboratories, dry docks, etc.

There will be no charge to students for this trip.

Students are cordially invited to attend all sessions and functions of the Spring Meeting.

No charge will be made for Student tickets for the Wednesday Luncheon.

Students are also invited to attend, without charge, the Floor Show and Dance, following the Dinner on Wednesday evening.

Local Committees on Arrangements

GENERAL

Francis S. Friel, General Chairman
Lester L. Lessig, Vice-Chairman
Charles A. Howland, Secretary
Neville C. Courtney, Treasurer

EXECUTIVE

Francis S. Friel, Chairman
Julius Adler
James H. Allen
Thomas Buckley
Carlos D. Bullock
Neville C. Courtney
Howard T. Critchlow
Ralph Earle
Joseph R. Farrell
Alexander Foster, Jr.
H. M. Freeburn
Mrs. Francis S. Friel
Charles A. Howland
Lyle L. Jenne
Joel D. Justin
Wilmer Z. Kline
Lester L. Lessig
Scott B. Lilly
L. D. Matter
Lemuel F. Parlette
Howard K. Preston
Henry J. Sherman
E. L. Shoemaker
S. M. Swaab
George H. Zeisler

PROGRAM AND TECHNICAL MEETINGS

Scott B. Lilly, Chairman
Julius Adler, Vice-Chairman
H. M. Freeburn
Thomas Buckley
Howard T. Critchlow
F. C. Claus
S. M. Swaab
Joel D. Justin
William H. Chorlton
Henry J. Sherman

PUBLICITY AND ATTENDANCE

James H. Allen, Chairman
W. D. Williams, Vice-Chairman
C. Laurence Warwick
Joseph A. Schulez
Charles S. Shaughnessy
Joseph E. Gill
R. E. Hess

HOTEL ARRANGEMENTS

Charles A. Howland, Chairman
Ralph Earle, Vice-Chairman
Howard T. Critchlow
Neville C. Courtney

REGISTRATION

L. D. Matter, Chairman
G. H. Zeisler, Vice-Chairman
Bernard S. Bush
Samuel T. Carpenter
Philip H. Carlin
John G. Gruss
Frederick T. Thorpe, Jr.
Ralph Earle
Charles S. Shaughnessy
Charles A. Howland
Fred G. Schworm
Sidney Robin
John T. Taylor
Mervin H. Kohler

RECEPTION—LOCAL HOST—SERVICE AND INFORMATION

E. L. Shoemaker, Chairman
C. D. Bullock, Vice-Chairman
Alfred A. Estrada
H. Lloyd Nelson
Howard T. Critchlow
Charles Haydock
Ralph Earle
Charles A. Howland
Sanford W. Sawin
Joseph J. Gilbert
Henry J. Sherman
Charles S. Shaughnessy
Wilmer Z. Kline
W. S. Pardoe
Lemuel F. Parlette
S. M. Swaab
Scott B. Lilly
H. M. Freeburn
Joel D. Justin
George B. Mebus

ENTERTAINMENT

Lyle L. Jenne, Chairman
H. M. Freeburn, Vice-Chairman
Charles A. Howland
James W. Weston
Joseph R. Farrell
Charles Haydock

JUNIORS

Scott B. Lilly, Chairman
Ralph Earle, Vice-Chairman
J. J. Brennan
Robert Diskant
A. C. Mullan
William Padlasky
T. D. Robinson, II
F. F. Smith

FINANCE

Alexander Foster, Jr., Chairman
J. G. Shryock, Vice-Chairman
Charles A. Howland, Secretary
Neville C. Courtney, Treasurer
Ralph Earle
Henry E. Ehlers
Joseph R. Farrell
Theodore E. Seelye
Joseph A. Russell
Joel D. Justin
Wilbur James
Carlos D. Bullock
Charles Haydock
Carl de Moll
Joseph J. Gilbert
William H. Gravell
H. Lloyd Nelson
Samuel I. Sacks
Barclay White
Charles H. Schwertner
Lemuel F. Parlette

TRANSPORTATION—EXCURSIONS AND SPECIAL TRIPS

Joseph R. Farrell, Chairman
C. P. Schantz, Vice-Chairman
Viggo Hansen
William R. Sauter
C. F. Wicker
Wilmer Z. Kline
Theodore Morris
Walter E. Rosengarten
Dudley T. Corning
Samuel S. Baxter
Eugene A. Hardin
Lemuel F. Parlette

STUDENT ACTIVITIES

Howard K. Preston, Chairman
W. H. Chorlton, Vice-Chairman
Samuel T. Carpenter
John A. Oakey
Samuel J. Leonard
Frank W. Edwards
D. M. Griffith
Philip Kissam

LADIES' RECEPTION AND ENTERTAINMENT

Mrs. Francis S. Friel, Chairlady
Mrs. James H. Allen
Mrs. Carlos D. Bullock
Mrs. Thomas Buckley
Mrs. N. C. Courtney
Mrs. H. T. Critchlow
Mrs. Ralph Earle
Mrs. J. R. Farrell
Mrs. Alexander Foster, Jr.
Mrs. H. M. Freeburn
Mrs. C. A. Howland
Mrs. Lemuel F. Parlette
Mrs. Lyle L. Jenne
Mrs. Joel D. Justin
Mrs. Lester L. Lessig
Mrs. Scott B. Lilly
Mrs. L. D. Matter
Mrs. Howard K. Preston
Mrs. Henry J. Sherman
Mrs. S. M. Swaab
Mrs. E. L. Shoemaker
Mrs. Wilmer Z. Kline
Mrs. George H. Zeisler

REGIONAL COORDINATION

Lemuel F. Parlette, Chairman
Carlos D. Bullock, Vice-Chairman

Allentown: George E. Pidcock
Baltimore: Gustav J. Requardt
Bethlehem: Jonathan Jones, H. A. Wistrich
Coatesville: William C. Emigh
Harrisburg: L. D. Matter, I. M. Glace, A. J. Warlow, Farley Gannett, H. E. Moses, J. R. Hoffert
Lancaster: John H. Wickersham
Millville: Newton B. Wade
Norristown: Joseph H. Green
Phoenixville: Harry K. Ellis, Clyde W. MacCornack
Princeton: G. P. Tschebotarioff
Reading: A. R. O'Reilly, Francis Heine
State College: Raymond O'Donnell
Suburban Philadelphia: Walter E. Rosengarten, Joseph J. Gilbert, David W. Bainbridge, Oliver L. King, Henry G. Damon, Samuel T. Carpenter, George B. Mebus
Trenton: F. C. Claus, Oliver W. Hartwell, Blair Birdsall, Henry C. Barksdale
Wilkes-Barre: Bernard S. Bush
Williamsport: Mark C. Krause
Wilmington: Sanford W. Sawin, W. Compton Wills, Harry S. Stanton, S. N. Van Trump

W. W. Horner
President

William N. Carey
Secretary and Executive Officer

Sydney Wilmot
Editor in Chief and Manager of Publications

Don P. Reynolds
Associate Editor

CIVIL
ENGINEERING

April 1946

Volume 16

Number 4

Committee on Publications

Harry F. Thomson
Chairman

John H. Gardiner
S. C. Hollister
William M. Piatt
Wilbur M. Wilson

W. L. Glenzing
Advertising Manager

What Can Be Done About Traffic Congestion?

Part I. The Problem We Face

By Leslie Williams, Assoc. M. ASCE
City Planning Engineer, American Transit Association, New York, N.Y.

TRAFFIC congestion is a serious, major problem confronting cities. A survey recently conducted within the American Society of Civil Engineers, asking each member of the City Planning Division to indicate what, in his opinion, was the major problem in the planning of cities in 1946, showed traffic congestion to be the number one problem, followed closely by slum clearance and urban redevelopment.

Traffic congestion is costly. It has been estimated that the national economic loss from it equals that incurred by traffic accidents, which according to the National Safety Council approached two billion dollars in 1941. The Regional Plan Association of New York estimated the cost of traffic congestion in 1927 on Manhattan Island at $500,000 a day, and in the New York Metropolitan area at approximately $1,000,000 a day. According to a recent *New York Times* nation-wide survey of traffic conditions, Boston experiences a loss of $40,000,000 of trucking business each year, and Detroit downtown property owners have already lost about a billion dollars from traffic congestion.

INADEQUATE PROGRAMS

The *New York Times* writer concludes that insufficient planning was in evidence to cope with the postwar traffic and parking problem. "Many communities," he continued, "had a feeling of helplessness, of being caught in a swirl of traffic with no adequate program of relief." Thus, if the tempo of our attack is not stepped up, and if our efforts are not coordinated, the cores of American cities will be threatened with an accelerated spreading of business blight, and the whole urban organism will suffer irreparable economic losses.

Traffic congestion is a complex problem, as is evidenced by the difficulty that is encountered in trying to define it. But it must be fractured into its basic elements if the proper remedies are to be prescribed, in the proper amounts and at the right place and time.

There are several varieties of traffic congestion. Home-to-work, mass-transportation passenger congestion is as familiar to the urban dweller as street vehicular and pedestrian delays and conflicts. Fortunately, all streets are not congested. If they were, the result would be tantamount to a streetless community, which would cease to function. These attacks of traffic congestion occur at fairly regular intervals and at definite places within the traffic system. Congestion is found along main thoroughfares leading to and from places of residence and places of mass employment during the a.m. and p.m. weekday rush periods. It occurs occasionally on major routes leading to and from beaches and recreational resorts on Sundays and holidays during vacation seasons.

Congestion is most acute, however, on local business streets within concentrated retail and mercantile centers. In these areas, adjustments sometimes take place within the composition of the traffic stream, espe-

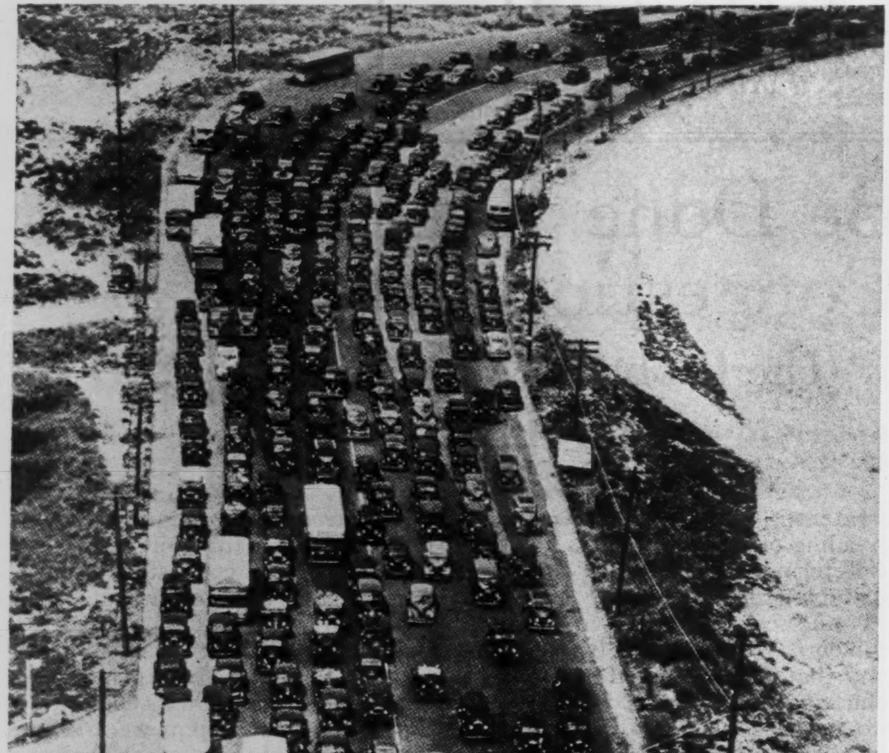
Measures to Relieve Traffic Congestion

Here are the results of the "decongestion" poll conducted at the Joint Session of the Highway and City Planning Divisions of the American Society of Civil Engineers in January 1946. Members present were asked to indicate which of the measures listed below will bring relief from traffic congestion quickly and cheaply in 1946. The vote was as follows:

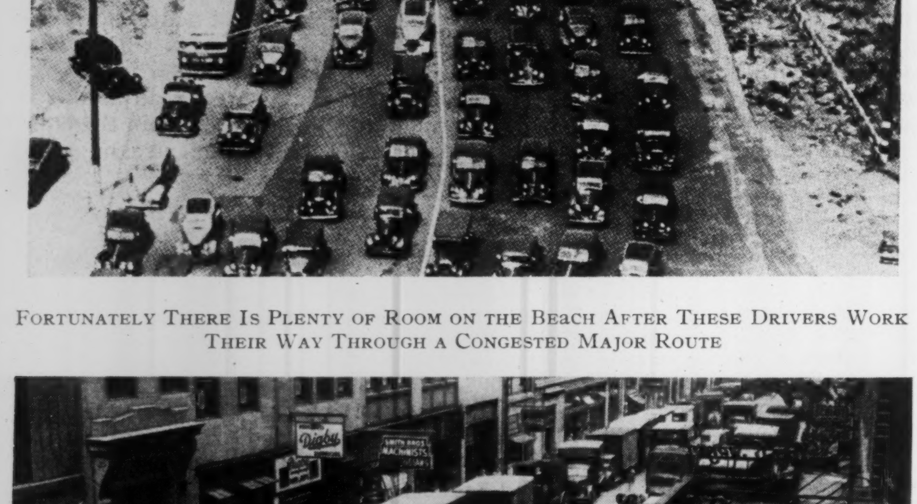
Percentage of Those Present	Corrective Policy Voted for
35.7%	Traffic engineering, meaning prohibition of car parking in business districts, one-way streets, modernized signs and traffic signals, etc.
24.5%	Mass transportation, in new and modernized forms
13.9%	More expressways and parkways
11.2%	More offstreet parking lots and garages
9.3%	Improved police enforcement
5.4%	City planning and zoning

Almost 70% of those participating in the "decongestion" poll voted for traffic engineering, mass transportation, and police enforcement, whereas the remaining 30% voted for long-range measures such as freeways, off-street lots and garages, and city planning.

cially if the district is growing. For example, at Fifth Avenue and 42d Street, in the heart of New York, private automobile congestion rose and waned in the face of a rising pedestrian and motor-bus passenger demand. In 1925 more private cars used this intersection than in 1939, when there were twice as many private automobiles registered in metropolitan New York. The movement of people and goods at this intersection is greater today than ever before, indicating that a downtown business site needs customers, not private cars, to prosper.



FORTUNATELY THERE IS PLENTY OF ROOM ON THE BEACH AFTER THESE DRIVERS WORK THEIR WAY THROUGH A CONGESTED MAJOR ROUTE



TRAFFIC STOPS AND WAITS—AND WAITS—CHOKED BUSINESS STREET IN NEW YORK

It must be recognized, however, that traffic is self-limiting. There is a maximum level beyond which traffic congestion causes decentralization and business decline. Therefore, in prescribing for the relief of such congestion, extreme care must be exercised in examining and diagnosing each particular local situation so that the proper correctives will be applied in the right proportions.

The Highway and City Planning Divisions of the American Society of Civil Engineers recognize the local peculiarities and complexities involved in applying palliatives, preventives, and remedies for traffic congestion. The members of these Divisions also realize that a clear and concise program of attack must be organized immediately because we stand on the threshold of the greatest urban highway building program in history. These highways will be a blessing or a blight on American urban economy depending upon the degree to which they promote the public's convenience, safety, prosperity, and general welfare.

ELEMENTS OF CONGESTION

For the purpose of initiating this discussion, traffic congestion may be considered as the inability of certain parts of public ways to generate, at times, their maximum utility owing to:

1. Lack of a functional major thoroughfare and expressway system
2. Inability of public transportation to provide such attractive service that the highest level of transit riding is maintained
3. Misuse of streets for private-car storage and commercial shipping purposes
4. Insufficient or improper traffic engineering and enforcement measures
5. Non-existence of a master land-use plan to guide the location and design of public ways and terminals

The mere mention of these major deficiencies in the circulatory systems of American cities brings to mind a general approach to traffic congestion, consisting of:

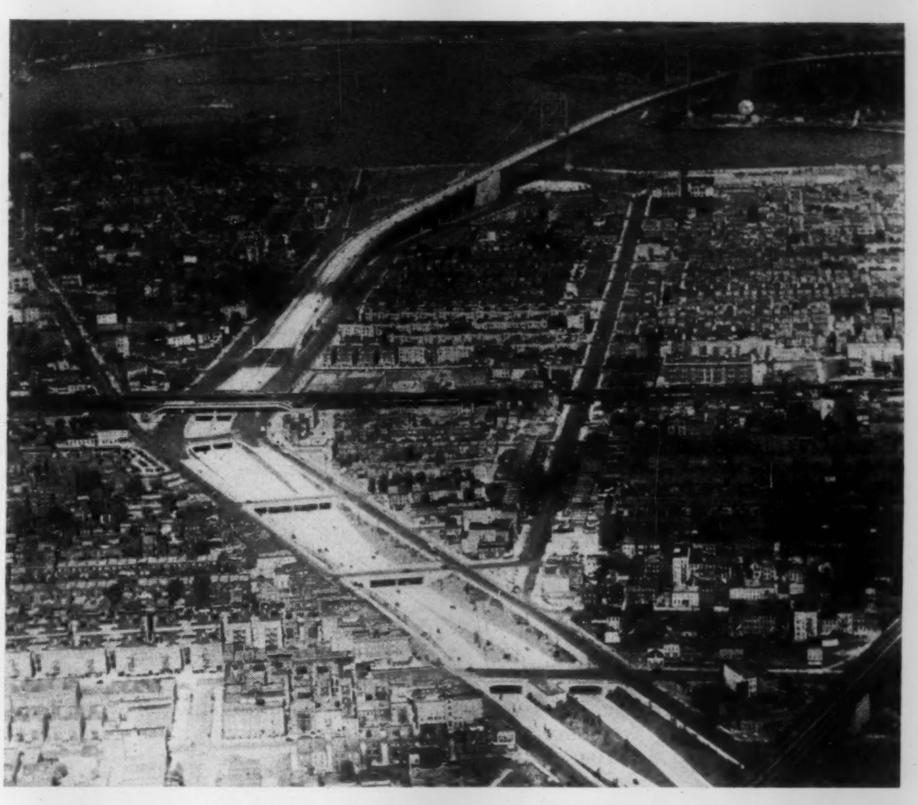
1. Major thoroughfare, freeway and parkway system
2. Modernized public transportation
3. Off-street private-car and truck terminals strategically located
4. Improved traffic engineering and enforcement measures
5. A city plan, integrating land uses (for residence, recreation, commerce, industry, and civic and cultural purposes) with the circulatory system

Each of these elements of the congestion problem will be analyzed in this symposium, the first in this issue and others in future issues. It is relatively simple to state a general program but quite the reverse to diagnose local conditions, select and apply particular remedies, and establish the proper administrative machinery for translating proposals into practice. It is also recognized that relief from traffic congestion can come only from a combination of correctives based on adequate factual analyses. As a part of that analysis attention must be given to that great dammed-up private-car demand waiting to pour such vehicles forth onto existing streets.

NEED FOR IMMEDIATE PROGRAM

There will probably be only a limited expansion in street space in 1946, and express highways, when built, will constitute only a fraction of the total street mileage. We seem to be confronted with the dual fact that our existing streets with few changes will have to carry the bulk of the movement of people and goods, and that our cities are in desperate need of a workable program for immediate relief.

The Highway and City Planning Divisions of the ASCE held a joint session in January, presenting this Symposium on Traffic Congestion with the hope that a decision might be reached on what to do to place sound traffic principles in operation at once, and at the same time to establish a sound guide for capital highway expenditures to facilitate the movement of people and goods, alleviate traffic accidents, preserve downtown business values, and encourage sound central city and suburban development.



Express Traffic Approach to the Triborough Bridge in Queens, New York City

Part II. Urban Parkways and Expressways

By W. S. Chapin

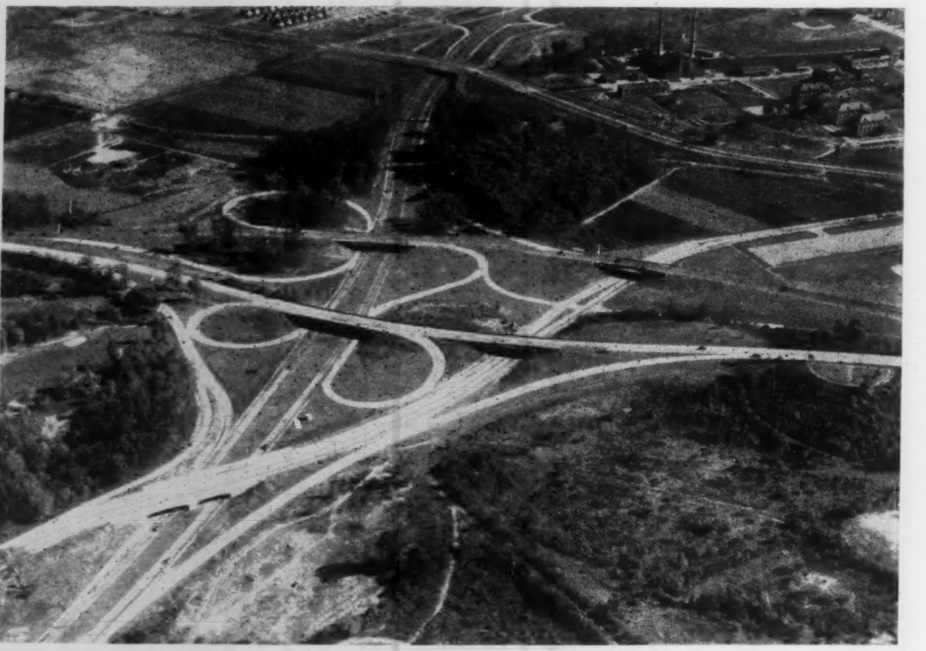
Consulting Engineer, Triborough Bridge Authority, New York, N.Y.

IMMEDIATELY after V-J day, when the restrictions on the use of motor fuel were lifted, most American cities experienced a surge of vehicular traffic that resulted in serious congestion in some areas. Midtown Manhattan traffic problems were high-lighted in the newspapers, and as a result all sorts of remedies were suggested, ranging from drastic restrictions on the movement, stopping, and storing of vehicles to the immediate construction, with public funds, of inordinately expensive engineering projects. Some of these projects could at best bring partial relief, and the cost would be so large as seriously to impair the city's ability to finance other worth-while public improvements.

By the exercise of reasonable police power, considerable relief was obtained and the hysteria accompanying Mid-Manhattan traffic tribulations died down. The problem is now being approached with sane, sound judgment and with a view toward alleviating the difficulty without imposing such restrictions as will strangle business in the area and without constructing facilities that are not economically sound. The first thing needed is more traffic police, and these will be available by midsummer.

Our objective is to provide reasonable freedom of movement for the greatest volume of traffic and to

Southern Parkway in Queens, New York City
Two Three-Lane Express Roadways Are Flanked by Service Roads



Fairchild Aerial Surveys, Inc.

INTERSECTION OF TWO PARKWAYS AND A HEAVILY TRAVELED BOULEVARD IN QUEENS, NEW YORK CITY, HAS ELABORATE LAYOUT

remove traffic from neighborhoods where it is detrimental to the community life. The modern parkway or expressway is a most important factor in carrying out this objective.

The manufacture of automobiles will continue, and the public desires, pays for, and demands the right to use the vehicles it buys and to travel without unreasonable restrictions from traffic congestion.

It was not until 1939, when *Toll Roads and Free Roads* was published under the direction of Commissioner Thomas H. MacDonald, Hon. M. ASCE, that the full significance of modern traffic trends was realized by many. The public has since become increasingly aware that the traffic load is in or near the confines of our cities. Gradually the Federal Aid Highway Act is being modernized to provide more adequately for urban problems, and most cities are now for the first time face to face with the many problems of construction involved.

For a great many years city streets have been paved, until in many instances between one-fourth and one-third of the area of the city blocks is paved for public use. In spite of this huge area of paving, the bulk of urban traffic has not been able to move in the expeditious manner it has a right to expect. In many cities movement within the city limits is slow and congested, as heavy traffic is moved along residential and business streets. Not only is traffic not properly served, but in addition the areas through which the traffic forces its way are adversely affected. Heavy traffic is not an asset to a business section. Instead, it drives away legitimate business that would otherwise patronize the area. Neither is heavy traffic beneficial to residential sections. It seriously depreciates the value of properties along streets that are subjected to the pounding of traffic and noisy stopping and starting at intersections.

MIXED TRAFFIC PROBLEMS

A lane of pavement on a city street has a very low efficiency, as its value is limited to that of the poorest traffic intersection on the street. Many factors are involved, such as light cycles, pedestrian movements, and vehicular turns. The pedestrian is entitled by law and by custom not only to the exclusive right to the sidewalk but also to a share in the use of the street. Attempts have been made to force him to pass under or over the streets at busy intersections, but too often without success. He simply insists on his right to use the street, and as a result is responsible for a material reduction in street efficiency.

The properly designed expressway, which is free of traffic lights, left turns, intersections at grade, and local access except at designated exits and entrances, and which separates the through from the local traffic and the vehicle from the pedestrian, is the only known way of reserving lane capacity for the unrestricted use of the motorist. Instead of lane efficiencies of 20 or 30%, as developed on city streets, efficiencies approaching the desired 100% are obtained on express lanes.

During the last fifteen years, under the leadership of Commissioner Robert Moses, 164 miles of free-flowing 4-lane and 6-lane parkways have been developed in and around New York City. It is generally recognized that these facilities have greatly reduced traffic congestion in the areas they traverse. The neighborhoods have been relieved of traffic that is detrimental to community life, while the benefits to traffic because of ease of travel and saving of time are manifold. In short, traffic on an express artery is virtually bridged through the communities without interfering with their life.

EXPRESSWAYS PLANNED

The expressways now being designed for New York City are generally similar to the parkways, except that commercial traffic will not be excluded. The present expressway program will dovetail into the arterial system and will go far toward filling in the vital gaps in the New York system. Other worth-while projects will be developed, but in general they must take their proper place in a list of projects that is based on realistic factors, including need and practicability as measured by both physical and economic standards.

The question of how much traffic relief will be afforded by the express highway system will depend upon how many projects are actually undertaken and how soon they are completed. Many cities have never really begun the construction of express highway facilities but are still in the planning stage. Some state highway departments have not as yet experienced the difficulties of construction within the boundaries of cities, where close coordination is required with the numerous city bureaus, including planning commissions, public works agencies, and traffic officials. Many city planning and works agencies have not as yet reconciled themselves to having state highway departments constructing and maintaining highway facilities within areas of their jurisdiction.

COORDINATED AUTHORITY

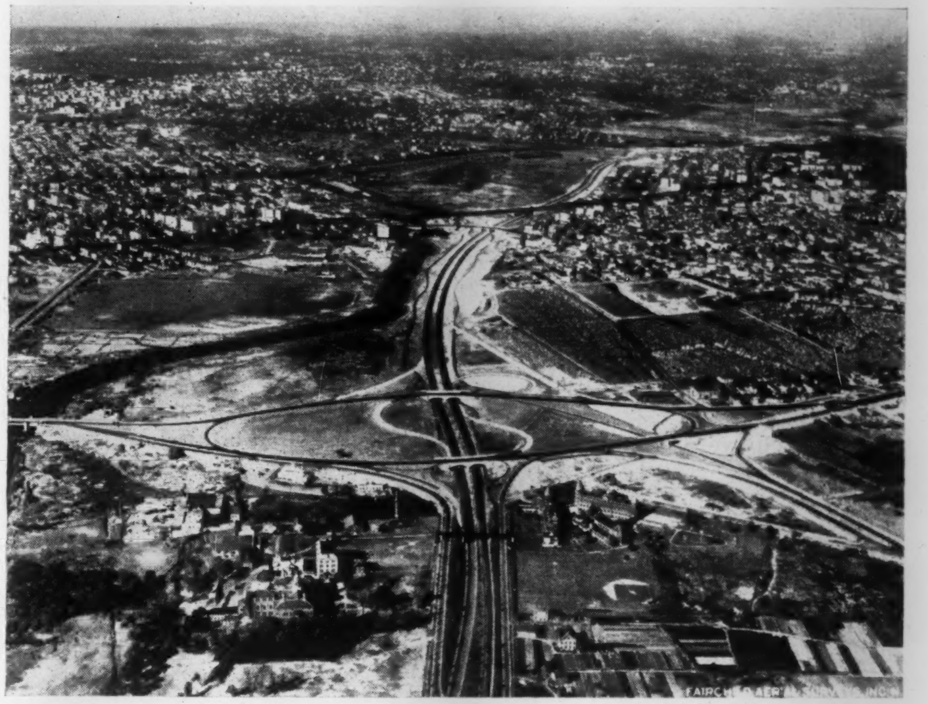
In New York the success in planning and constructing arterial projects of intricate design is due to the overlapping directorship of Commissioner Moses, who holds a number of state, city, and authority jobs. Commissioner Moses has been able to coordinate the entire arterial program, in addition to the many other improvements which are related to the planning and construction of this program. Even under such favorable conditions, the problems are far from simple, and tremendous energy is required to advance the program from studies to design, and from design to land acquisition, building demolition, and the actual moving of dirt and building of structures.

TECHNICAL COMMITTEES

In the absence of efficient coordinated direction for the program, other expedients must be resorted to. One method that has been found successful in the past is to establish technical committees consisting of the heads of the planning and works agencies involved in the program. The technical committee can establish itself as a body of considerable influence, particularly with the public officials who have final authority and who are responsible to the public.

In addition to a coordinating committee, another successful expedient is to use liaison engineers who have sufficient authority to work out the problems between the agencies involved, and who by personal contact rather than by letter writing bring about the necessary compromises.

Of the large number of traffic intersections on the New York City and Long Island parkway system, there are practically none on which any one man could claim the entire credit for the design. The reason for this is that early in the design stage the liaison engineer obtained the contributions and suggestions of the several organizations involved.



ALL INTERSECTIONS OF HUTCHINSON RIVER PARKWAY IN THE BRONX, N.Y., ARE SEPARATED

There is no room for pride in authorship, only for pride in partnership, where several agencies, oftentimes of different political faiths, have a combined responsibility to design and construct the same facilities.

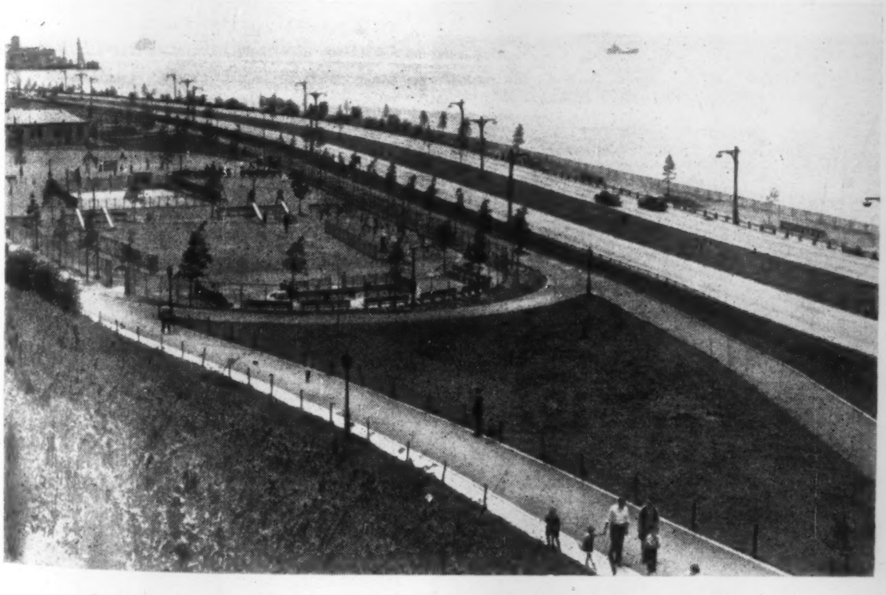
COMBINED WITH OTHER ESSENTIALS

The expressway cannot any longer be considered as a highway facility completely separate from the other transportation elements affecting the growth of a modern city. In cities where separate rapid-transit facilities cannot be afforded, it is possible that either rail or motor mass transport can be combined in the expressway program. A number of suggestions have been proposed along this line, placing rail transportation in the landscaped median strip between the express roadways and providing for stations at important crossings of the expressway.

The Pentagon highway network in Arlington, Va., is an example of express highway facilities being used as a base for the development of a number of facilities, including offices for the Army and Navy, and housing for government employees. Before the network was constructed, traffic congestion was extremely serious. In spite of the tremendous expansion of activities throughout the area during the war, the traffic is no longer a matter of concern.

A NEW CONCEPT

The possibility of completely integrating express highway facilities within the overall plan of the American city is only now taking form. Those cities that have as their objective the development of reasonable freedom of traffic movement, the removal from the street system of traffic detrimental to community life, and the orderly development of new facilities dependent on modern methods of transportation, will feature the modern parkway and expressway in their construction programs.



PROMENADE AND RECREATIONAL FACILITIES ARE PROVIDED ALONG THE SHORE PARKWAY IN BROOKLYN, N.Y.

Testing Bailey Bridges to Failure

By D. Allan Firmage, Jun. ASCE
Engineer (Civil), Engineer Board, Fort Belvoir, Va.

A GREAT many interesting and valuable engineering data have been obtained in tests of war equipment. An example directly to the point is the series of tests on bridges made by the Army's Engineer Board. Conducted on a scale beyond the hopes of most researchers, the field tests shed light on the behavior of long spans of assembled prefabricated bridge-truss units.

THE bank of the Colorado River near Imperial Dam, Calif., was the scene of one of the war's large-scale fact-finding projects. Here at the Yuma Test Branch of the Engineer Board, Army Engineers assembled and loaded to failure full-size bridge spans assembled with interchangeable Bailey bridge units. The tests, which were run during 1944 and have only recently been made public, were a final check on the American redesign of the British bridging units so widely used throughout World War II. The tests were unique for several reasons: (1) They are one of the most complete series of ultimate-capacity tests of full-size bridges ever conducted in the United States; the series consisted of tests on 17 individual Bailey bridges. (2) They cover a very comprehensive use, on full-size bridges, of the electrical-resistance type of strain gage. Over 1,500 individual measurements were made on one bridge. (3) Along with the other tests of bridging equipment conducted by the Engineer Board during the war, they constitute one of the most extensive uses of the electrical-resistance type of strain gage for field testing.

The main reasons for the series of tests were three. The first was to check the capacity of United States manufactured bridges against that of British manufactured bridges. With the decision to make Bailey bridges in the United States, it was necessary to redesign the British bridge using American standard rolled sections. However, all parts had to be interchangeable with British parts, and the bridges also had to be capable of carrying the same live load as British bridges. The British had made ultimate-capacity tests on their bridges and from the results had classified them as to allowable live load.

The second reason was to check the analytical method for determining both dead-load and live-load stresses due to a particular vehicle on the structure.

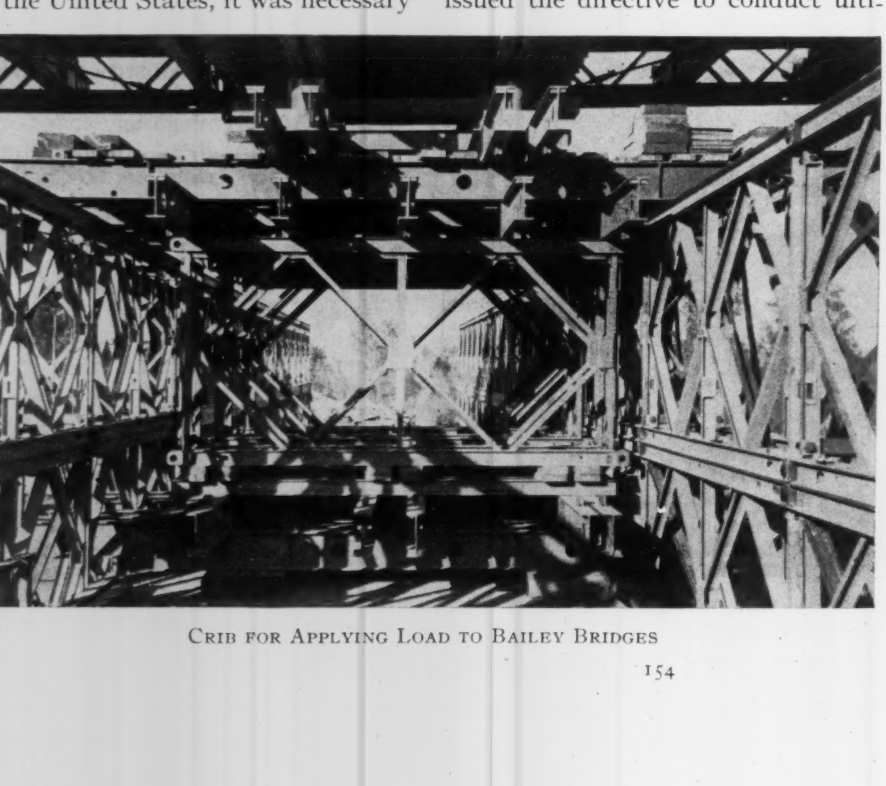
Third, it was necessary to determine the limit strength of the bridge for the five types of construction, from single-truss single-story to triple-truss double-story. Because of the complexity of the structure, it was not possible to determine mathematically, to the degree of exactness necessary in military bridging, the buckling strength of the compression chord.

Before the Chief of Engineers issued the directive to conduct ultimate-capacity tests on the United States manufactured Bailey bridge, the Engineer Board had not conducted any ultimate-capacity tests of non-floating bridges. Therefore a method had to be devised to load the bridges up to a maximum of 100 tons. The first thought was to drive a tank onto the test bridge and then load weights on the tank until the bridge failed. This method was ruled out as impractical for the following reasons:

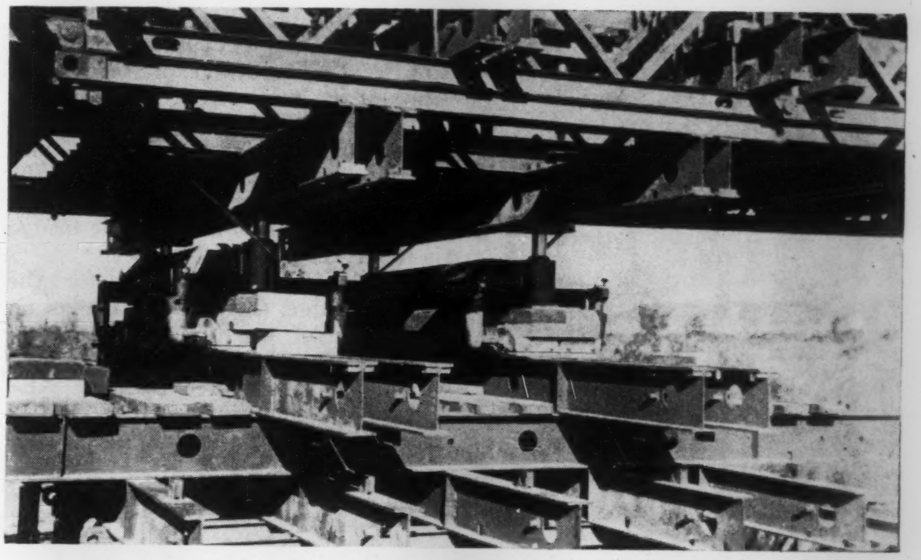
1. The amount of added weight would be as great as 50 or 60 tons for some bridges. It was doubtful if the suspension system of the tank would carry this load.
2. It would be difficult to procure lead or iron weights in such quantity in the limited time available.
3. In order to conform to the British posted capacity, the American bridges had to carry eleven applications of the British limit load with no increase in deflection between the tenth and eleventh applications. The time involved in eleven applications of 50 to 60 tons of weights to the test vehicle would have been excessive.
4. By adding weights to a tank it would be difficult to insure equal distribution of load to both tracks.

After considering the time required to complete the tests and the materials on hand, the need of improvising a testing machine of 100-ton capacity was apparent. It was decided to utilize two sets of pile piers previously erected for testing pile-driving equipment. By launching a Bailey bridge from a nearby road along the top of a sand bank onto the two pile piers, a continuous overhead bridge of two 60-ft spans, approximately 20 ft above the ground level, was obtained.

Below this overhead bridge, and perpendicular to it, the bridge to be tested was constructed. The test bridge was then loaded by: (1) placing simulated tank tracks (made from timbers and conforming to the track dimensions of the design vehicle for the British load class for which the bridge should be rated) on the bridge at mid-span and against the curb; (2) erecting on the simulated tank tracks a crib composed of Bailey bridge parts; (3) placing on top of the crib four sets, two to a set, of standard highway loadometers; (4) installing a hydraulic jack on each set of loadometers. By jacking against the overhead bridge, which



Crib for Applying Load to Bailey Bridges



A 150-Ft Triple-Double Bridge Undergoing a Capacity Test

was carrying several vehicles, the load was applied to the test bridge.

Under this test setup it was possible to vary the bridge load from approximately 10 tons, the total weight of the crib, to a maximum of approximately 100 tons. The arrangement of the crib insured equal distribution of load to the simulated tank tracks as well as an evenly distributed load along the length of the track. Applying the load was simply a matter of jacking up on all four jacks simultaneously until the desired load was reached, being sure that the loads on all the jacks were equal. Releasing the load was only a matter of releasing the jacks. The complete crib was composed of standard Bailey bridge parts, which were already in the stock pile at the test site. The loadometers were also readily available, having been used in previous bridging tests to weigh test vehicles. The overhead bridge was weighted with three tanks having a gross weight of approximately 90 tons. The steel sections beneath the bridge were for the purpose of catching it at the time of failure so as to avoid danger to personnel on the bridge.

STRESSES AND DEFLECTIONS

Measurements were made by means of electrical-resistance strain gages and the SR-4 type of strain indicator. Gages were placed on both the compression and the tension chords at several critical sections. The chords of the panels were composed of two 4-in. channels tied together at the intersections of the diagonals and verticals. All the steel in the panels had a guaranteed minimum yield point of 50,000 lb per sq in. and an ultimate tensile strength of 70,000 lb per sq in.

After testing, sections were cut from the channels of some of the panel chords. These sections were then tested for yield point and ultimate tensile strength. The actual yield point varied from 50,000 to 56,800 lb per sq in., and the ultimate tensile strength from 73,000 to 84,000 lb per sq in. To obtain the average strain in the channel, four gages per channel at any one section were installed. This arrangement of gages on the channel would measure the extreme fiber stresses. Then, by weighing the four gage readings in proportion to the area of the flanges and the web of the channel, average stress in the channel was obtained.

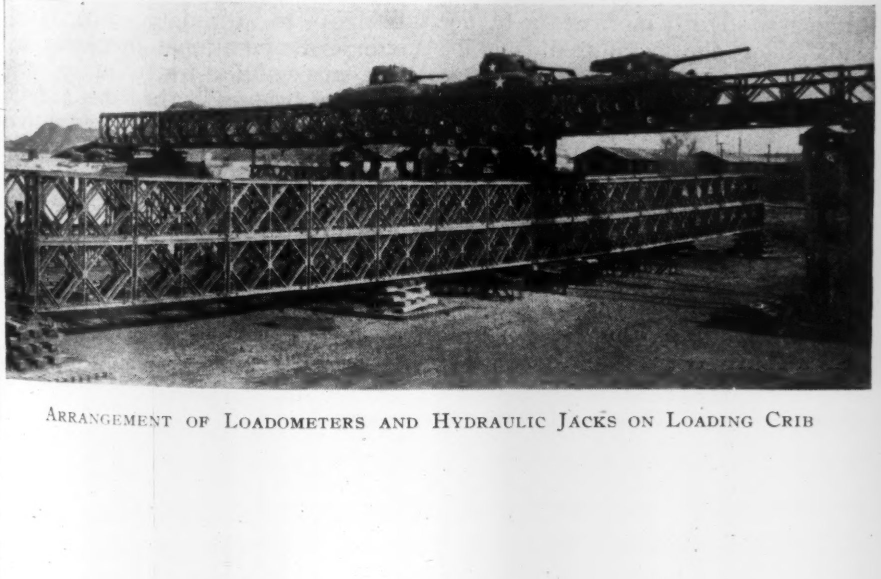
The number of gages per bridge varied with the type of construction, 84 gages being the maximum installed on any one bridge. The gages were wired to panel switch boxes and the switch boxes were connected to the strain-gage indicator. At any time it was possible to take a reading of any particular gage by simply switching that gage into the circuit. With this setup it was possible to take readings of all 84 gages in 10 to 15 minutes.

Deflections of the bridge were measured by attaching scales to the bottom chord and taking readings by means of an engineer's level. Readings were also taken at the abutments to measure any settlement of the supports. Horizontal movements of the compression chord were also measured. These measurements were made by clamping a transit to the top chord at the end of the bridge and reading offsets at the joints by holding a scale against the chord at each panel pin. Strains for dead load were measured by jacking up the center of the bridge and removing the pins connecting the center panels.

Thus assured of no stress in the chords, the personnel took a reading of all the strain gages. The pins were then inserted and the bridge jacked down to its normal position. All the gages were again read and the difference in the two readings was a measure of the dead-load strain. Next the loading crib was constructed, and at its completion another set of readings was taken. This gave the measurement of strain due to the crib load. The live load was then increased in increments by jacking against the overhead bridge.

At increments of load near failure, the load was applied 11 times and deflection and strain gage readings were taken at the first, tenth, and eleventh application of load. The measurements of dead load and crib load were completed in one working day, and readings of live-load increment were completed the second day.

Electrical-resistance strain gages are ideally suited to this type of field testing. They are easily applied, and the rapidity with which they can be read was a highly important factor in these tests. The sensitivity of the gages was valuable in observing the slow rate of failure that was frequently noted. Many of the bridges tested carried the load at failure for a considerable period of time before



Arrangement of Loadometers and Hydraulic Jacks on Loading Crib

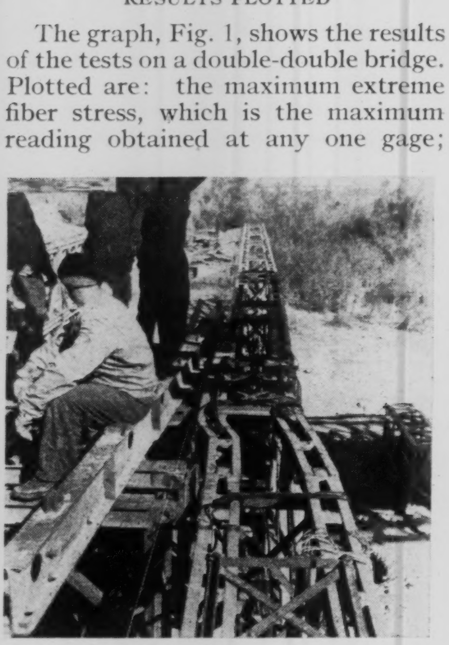
ELECTRICAL STRAIN-GAGE EQUIPMENT IN PLACE ON COMPRESSION MEMBERS

they collapsed. In one case a bridge sustained the failure load for one and one-half hours before collapse. During this entire time the strain-gage recorder showed a very slow increase in strain with no increase in load. It was not otherwise possible either by observation or by deflection measurements to know that the bridge was going to fail until less than one minute before collapse.

At least two tests of each span and type of bridge tested were made. This was done by removing the middle half of the bridge after the first test and replacing it with new panels. The results obtained from the strain-gage tests are too voluminous to cover completely in this article. However, several of the tests will be briefly discussed.

RESULTS PLOTTED

The graph, Fig. 1, shows the results of the tests on a double-double bridge. Plotted are: the maximum extreme fiber stress, which is the maximum reading obtained at any one gage; the maximum average stress in the greatest stressed channel, which is the weighted average of four gages; the maximum average truss stress, which is the weighted average of the two channels comprising the compression chord of a panel; and the maximum average girder stress, which in the case of a double-double bridge is the average of two trusses.



COMPRESSION CHORD BUCKLED AFTER ULTIMATE LOAD HAD BEEN PASSED

In military terminology for the Bailey bridge, the group of trusses on each side of the bridge is called a girder. The girder may be composed of one, two, or three trusses. Also shown on the graph is the dashed line representing the computed maximum average girder stress. This was computed by treating the bridge as a statically determinate structure. This is not exactly the case, as each panel has moment-resisting joints since all members are joined by welding. However, as the stiffness of the web members is very small in proportion to that of the chords, the panel can be treated as pin jointed.

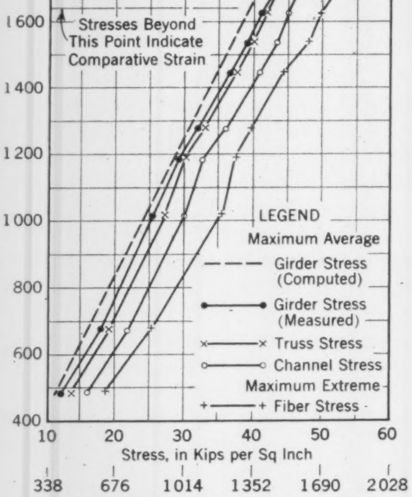


FIG. 1. STRESSES IN COMPRESSION CHORD OF A BAILEY BRIDGE UNIT

The plot shows that the measured average girder stress for the test bridge was slightly more at the higher loads than the computed average girder stress. However, the average stress for all the girders was very close to the computed average. It was also observed that the maximum extreme fiber stress was considerably greater than the average channel stress. The latter shows a considerable variation in stress across the section—a characteristic of all the tests.

There was quite a difference in the stress at the heel and that at the toe of the channels, although there was no mathematical relationship between these stresses. The maximum extreme fiber stress was very erratic, and it was not possible to determine it analytically with any degree of accuracy. In any two tests of similar bridges, the extreme fiber stress was not consistent and there was no relationship found between the extreme fiber stress and the failure point of the bridge. The erratic character of the extreme fiber stress was no doubt due in great degree to the method of connecting the panels together by means of pins through the chords.

Although the specifications called for very close tolerances and exact workmanship, the play in the joints made it possible to place a slightly eccentric loading on the chord. The average truss and girder stress was consistent for all tests and conformed closely with the computed stress. The average girder stress at failure varied from about 40,000 to 50,000 lb per sq in., depending on the number of trusses per girder. This would indicate a low L/r ratio for the compressive chord. Tests of like bridges showed very similar strains, and such bridges were very similar in maximum load carried. The variation in ultimate capacity was within the permissible variation in yield point of the material, cross sectional area of the members, and accuracy of load measurements.

The method of testing here described proved very successful and made it possible to complete the tests ahead of schedule. Under the setup, the load could be applied quickly and in any increment desired. The electrical strain gages made possible the rapid measurement of strains at many points on the bridge. They also permitted the complete gaging of a section so as to obtain accurately the average stress in it. The stress variation across a section showed the error that would result in taking only one reading on a channel and accepting it as the average stress in the channel at that section. The Engineer Board has adopted this method of testing bridges to ultimate capacity as standard operational procedure and has successfully tested many other types of bridges in the same manner.

In conducting the tests and analyzing the data, the author was assisted by Maj. R. B. Stegmaier, Corps of Engineers, Jun. ASCE, and Lt. R. G. Jacoby, Corps of Engineers, Jun. ASCE. The testing was conducted at the Yuma Test Branch of the Engineer Board, Imperial Dam, California. The Yuma Test Branch was under the direction of Lt. Col. George W. Howard, Corps of Engineers, Assoc. M. ASCE.

The Case for Break-Point Chlorination

Three Cases Described to Illustrate Principles and Methods of Dealing with Various Conditions

By Robert N. Clark

District Sanitary Engineer, State of New York Department of Health, Ithaca, N.Y.

EVER since it was discovered that taste-producing compounds in drinking water could be oxidized out by heavy doses of chlorine, there has been a widespread interest in break-point chlorination. The purpose of such chlorination is twofold. It provides a means of maintaining higher chlorine residuals in a distribution system with a correspondingly greater protection to the health of consumers, and it may overcome critical taste difficulties encountered with other methods of chlorination. Like many phases of water treatment, it has its limitations and although some applications have yielded good results, other trials have been disappointing. Some of the failures have been due to a lack of understanding of the basic principles and methods of control, but there are many instances where break-point chlorination is not suited to conditions, and in those cases it should not be considered.

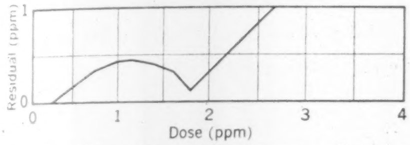


Fig. 1. Three-Phase Concept of Break-Point Chlorination

CHARACTERISTIC EXAMPLES

Some experiences with break-point chlorination have been chosen here to illustrate principles in laboratory and plant control, together with the practical difficulties encountered. The cases include the following three: a small Army post drawing its supply from a large metropolitan system, a municipality supplied from a heavily polluted stream, and an Army establishment using a relatively pure spring-fed stream but with a storage reservoir containing objectionable algal growths. These examples are distinctive but also characteristic, and illustrate methods of dealing with a range of problems.

It is first necessary to define break-point chlorination. The early concept of it is illustrated in Fig. 1. The reaction presented by this diagram may be divided into three phases. In the first phase, after the instantaneous chlorine demand is satisfied, successive increments of chlorine produce corresponding increases in the residual up to a definite maximum, beyond which further small increases in dosage yield no material increase in residual. The second phase is marked by a decrease in residuals as the dosage is increased, this trend continuing to a definite minimum residual, designated the break-point, beyond which further small increases in dosage yield no material decrease in residual. The third phase is characterized by a proportional increase in residual upon successive increments in dosage.

NEW concepts on the chlorination of water supplies have revealed procedures for successfully removing objectionable fractions. During the year 1945 special opportunities have been offered investigators to study the results of break-point chlorination—utilizing a relatively high dosage. In this article Colonel Clark has selected several examples illustrating the possibilities presented by this trend.

NEW BREAK-POINT DEFINITION

The discovery of this type of reaction aroused great interest in the water works field. As further experiments were made it was revealed that although some natural waters possess characteristic break-point properties, a larger proportion are of such a nature that the typical "hump" does not exist. However, many of these waters, after chlorination, were found to have properties similar to break-point chlorinated water, and it was suspected that some other factor was masking the classical break-point phenomenon.

Development of the orthotolidine-arsenite test, by Gilcreas and Hallinan, placed a practical tool in the hands of investigators, and led to a new definition of the break-point. This test differentiates between free available chlorine and loosely bound chlorine, such as chloramine. A typical break-point curve is shown in Fig. 2.

FOUR ZONES

This figure illustrates four zones of chlorination based on the applied dosage. In natural waters one or more of these zones may be very limited, or wholly lacking. The first zone represents the instantaneous demand, ordinarily a direct and stable formation of chloride such as the combination of chlorine and hydrogen sulfide, to form colloidal sulfur and hydrogen chloride. The second zone represents the loose combination of chlorine with some chemical, ordinarily ammonia, to form compounds that react with orthotolidine to produce color. This zone may be called chloramination and can be artificially produced or extended by adding ammonia to the water.

The third zone represents a mixture of free available chlorine and com-

First Service Command U.S. Army

Mobile Laboratory Used in the First Service Command for Water Tests

First Service Command, U.S. Army

INTERIOR VIEW (LEFT SIDE, REAR) OF MOBILE LABORATORY USED IN THE FIRST SERVICE COMMAND FOR EXPERIMENTAL WORK

bined chlorine, and has been designated marginal chlorination. In some instances it has been found that troublesome chlorinous tastes develop in this range. The fourth zone is characterized by absence of combined chlorine, all the chlorine indicated by the orthotolidine test being free and available. This is the true break-point range, and the break-point can be defined as the point at which all, or practically all, of the total residual is free, available chlorine.

To determine the practical possibilities of break-point chlorination, a series of full-scale tests was run early in 1945 at a small Army post drawing its water from a metropolitan supply. The water was a soft, clear surface water, slightly acid in reaction, and had been previously chlorinated, although no trace of residual chlorine was found in it as delivered to the post. Because the water was corrosive, the Army was applying corrective chemicals, which had the effect of raising the pH to about 8.0. These chemicals were sodium hydroxide, sodium silicate, and sodium hexa-metaphosphate, totaling in all about 25 ppm. It was found that the addition of these chemicals had the effect of increasing the instantaneous chlorine demand to a marked degree. The purpose of the study was fourfold: to determine the chlorine-demand characteristics of the water before and after treatment for corrosion control, to determine the persistence of chlorine residuals following break-point treatment, to investigate the bacteriological effects, and to study factors of consumer perception.

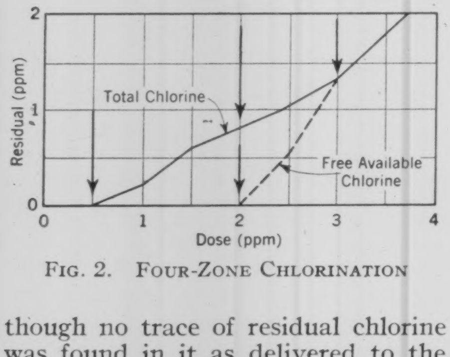


FIG. 2. FOUR-ZONE CHLORINATION

DEMAND CURVE

The chlorine-demand curve of the treated water is shown in Fig. 3, which indicates that the break-point dosage of 4.8 ppm of chlorine could be expected to produce a residual of 1.9 ppm under standard conditions. Accordingly the chlorine feed was adjusted to yield a 1.9 ppm residual after 10 minutes of contact, and within narrow limits was kept at that rate for the period of the test.

At different points in the distribution system the effect of this dosage was investigated. For several months prior to adoption of break-point chlorination, chlorine had been applied in amounts sufficient to produce about 0.4 ppm in the most used portions of the system. As soon as the dosage was increased, there was an increase in residuals throughout the system, even in remote sections where no chlorine could formerly be detected.

At first the residuals were mainly chloramines, except at taps near the point of treatment, but within a month some free available chlorine could be found throughout the system. Since the penetration of free available chlorine was progressive, it appeared that the system was gradually being cleared of nitrogenous material. In this case there was no sudden sloughing of pipe growth, even though break-point chlorination was suddenly applied.

The study of tastes, odors, and other factors perceptible to consumers indicated that no appreciable disturbance was caused by break-point treatment. Routine determinations of threshold odors were supplemented by direct questioning of cooks, officers, and enlisted men, and it was obvious that the change in treatment had not resulted in any perceptible change in taste. This is notable in view of the fact that the residual had been increased to about 500% of its previous amount.

SMALL MUNICIPALITY

As the second illustration, a small municipality has been chosen. Here the supply was contaminated with wastes from a potato starch factory some distance upstream. The amount of putrescible matter was so great that the oxygen in the stream was entirely depleted, and a strongly objectionable amount of hydrogen sulfide was present. Treatment consisted of conventional rapid sand filtration with the addition of carbon for taste removal and lime for pH adjustment. The chlorine-demand curves for the raw water are shown in Fig. 4. The break-point is quite definite at a dose of 5.0 ppm, but when a quantity of water was treated with this dosage the chlorinous taste and odor were decidedly offensive. The experimental results were so discouraging that no effort was made to carry out plant scale work. The objectionable condition was corrected by eliminating the polluting substances at the source rather than by further efforts at corrective treatment.

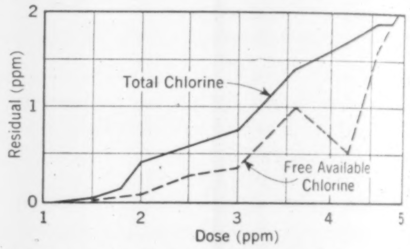
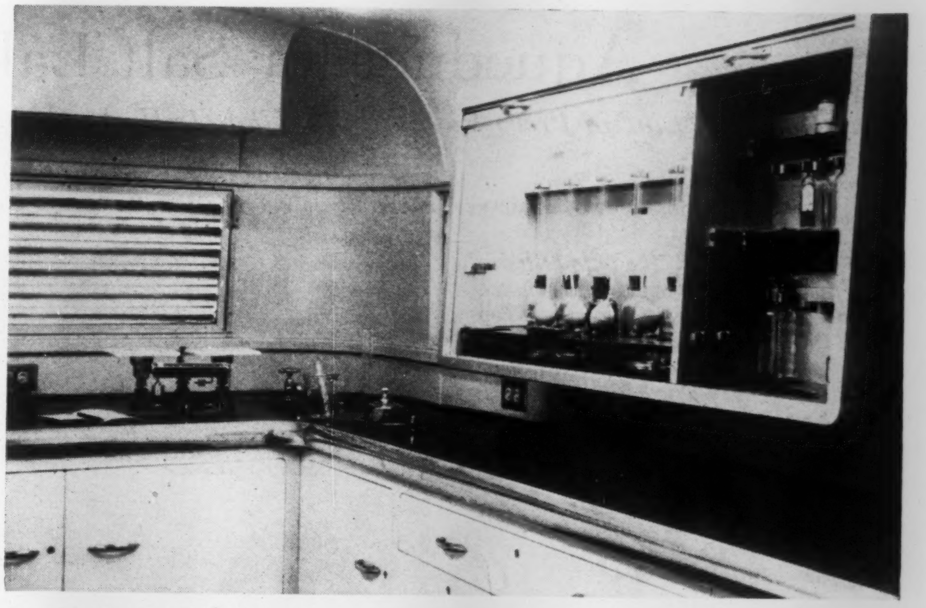


FIG. 3. CHLORINE-DEMAND CURVE OF TREATED WATER

The third instance was at an Army post which experienced trouble with tastes due to algae in the main distri-



First Service Command, U.S. Army

Right Rear View of Inside of Mobile Laboratory Used for Water Testing by First Service Command

bution reservoir. Preliminary tests were made on the raw water, and the break-point characteristics were determined, as shown in Fig. 5. The results obtained in the laboratory were excellent, and water treated with 4.0 ppm, to produce a break-point residual of 2.4 ppm, was found to have a very slight chlorinous odor, and no discernible taste. On application to the system there was a slight taste and odor disturbance.

Samples were taken daily from a sampling point several hundred feet below the point of treatment on the main supply line, and the threshold odor was determined as well as free available and chloramine residuals. A slight progressive decrease in odor, and penetration of free available chlorine to the sampling point led to a decision to flush this line. Flushing was undertaken a week after break-point chlorination was initiated and resulted in a marked improvement. This experience led to a systematic flushing of the entire system, and the mild difficulty with chlorinous taste was brought under control. No further trouble with tastes was experienced during the several months that break-point chlorination was practiced.

TIMING ERRORS

In conducting laboratory determinations on different supplies, several points were observed to be significant. The orthotolidine-arsenite (OTA) test has been described in the literature (March 1944 *Journal* of the American Water Works Association) but has not been officially standardized, and during these investigations several modifications in the test were evaluated. One of the important considerations was found to be careful timing of the contact period, from the instant the chlorine dose is added until the introduction of orthotolidine.

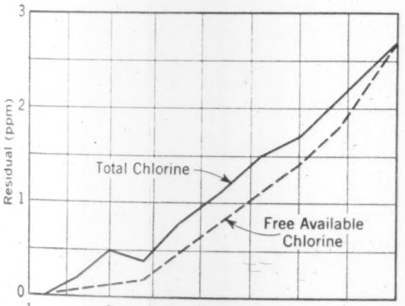


Fig. 4. Chlorine-Demand Curve of Raw Water

In one instance, samples of natural water were chlorinated and stored, and portions withdrawn for testing at stated intervals to measure the persistence of chlorine residual. It was found that loss of chlorine was most rapid during the first interval of time following chlorination, and that the percentage rate of loss over periods up to 60 hours was more or less variable. This experiment showed clearly that at the standard contact period of 10 minutes, the rate of loss of residual chlorine is so rapid that any material variation in timing can result in appreciable error unless this factor is taken into consideration.

AMMONIATION FROM ATMOSPHERE

It was also found that during the contact period any unnecessary handling of samples, which might produce turbulence or undue aeration, had a significant effect on the residual. In this connection a series of extraordinary results at one installation led to an investigation of ammoniation by atmospheric contact. It was found that definite amounts of ammonia were being absorbed from the laboratory atmosphere, and that as a consequence ammonia was entering into combination with free available chlorine in the samples under study, yielding data of a decidedly misleading character. In addition to the possibility of contamination with ammonia, the unnecessary handling of samples tends to release chlorine from solution, and leads to direct loss by aeration. The effects of high temperatures and direct sunlight on chlorine solutions are so well understood that no further comment in those directions is considered necessary.

One modification of the colorimetric determination of chlorine which simplified field work was the use of two sets of color standards, with appropriate compensating tubes. One set of standards was graded in whole parts per million, and another set in tenths of a part per million. By superimposing tubes, readings were made in increments of one-tenth ppm over the entire range of the set.

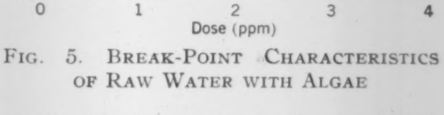


Fig. 5. Break-Point Characteristics of Raw Water with Algae

The work done on break-point chlorination during the year 1945 has not only yielded tangible results, but has stimulated the interest of many qualified investigators. The full-scale experiments here described in part, have been supplemented by a considerable amount of laboratory and research work, and much credit is due to the Sanitary Corps and Corps of Engineers personnel who have devoted their energy to the subject. The active support of manufacturers and of engineering schools and colleges is also acknowledged with thanks.

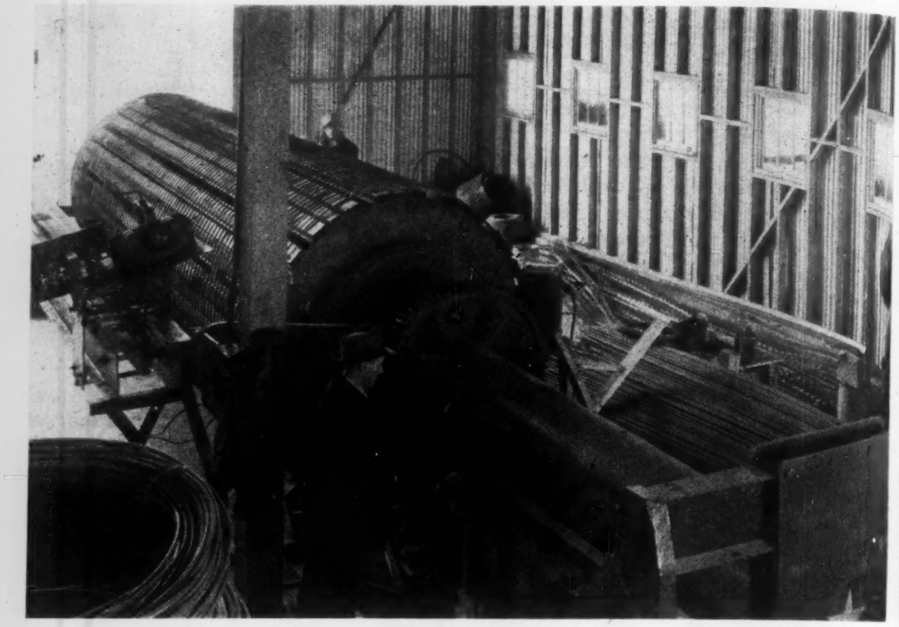
Aqueduct for Salt Lake City

Forty-One-Mile Line in Provo River Project, Utah, Is Under Construction by Bureau of Reclamation

By L. R. Dunkley

Construction Engineer, Provo River Project, U.S. Bureau of Reclamation, Provo, Utah

More than half the population of the State of Utah, it is estimated, will be benefited directly by the Provo River Project. One of its most important features is the Salt Lake Aqueduct, which will convey a needed increase in the water supply of Salt Lake City, as well as supplemental water for irrigation and for contiguous communities. A contract for a $10^{1}/_{2}$-mile low-head section of the aqueduct was recently completed. Mr. Dunkley tells how the pipe for this section was made, transported, and laid—in units weighing 23 tons or more each.



Winding Steel Reinforcing Cages for 69-In. Concrete Pipe

Utah's largest reclamation development, the Provo River Project, includes as one of its important features a 41-mile aqueduct (Fig. 1) to carry water from Deer Creek Reservoir in Provo Canyon to Salt Lake City. This will assure the city an adequate supply in times of drought and will meet the increasing demands of its growing population. The project will directly benefit residents of Utah and Salt Lake counties, or more than half the population of the state; it will provide for the storage and delivery of a supplemental water supply for 100,000 acres of farm lands and will furnish additional municipal and domestic water for the cities and communities adjoining the irrigated areas.

Deer Creek Dam, on the Provo River about 16 miles northeast of Provo, has been completed. It rises a maximum height of 235 ft above its foundation and extends 1,300 ft between the canyon walls at crest elevation. It is the fifth largest earth-fill dam to be constructed by the Bureau of Reclamation, and has created a reservoir $6^{1}/_{2}$ miles long with a capacity of 150,000 acre-ft. In addition to storing Provo River waters, this reservoir impounds flood waters diverted from Weber River by the Weber-Provo diversion canal. When the 6-mile Duchesne tunnel is completed, water will also come for storage from the Duchesne River in the Colorado River watershed.

Since work began on two tunnels in 1939, the Salt Lake Aqueduct has been more than half completed. It consists of 41 miles of a 69-in. pipe line, 4.2 miles of which are tunnels. Over $22^{1}/_{2}$ miles of reinforced-concrete pipe have recently been completed. Bids have been called and contracts recently awarded for the construction of $4^{1}/_{2}$ miles of steel pipe to link the completed concrete-pipe sections of the aqueduct across high-head reaches (Fig. 1).

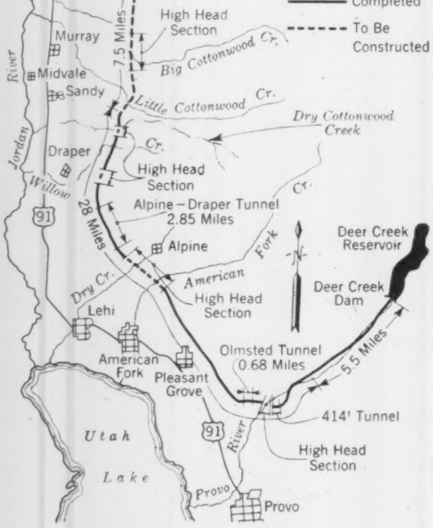

Salt Lake City
Sam Parker Reservoir
LEGEND
Completed
To Be Constructed
High Head Section
7.5 Miles
Big Cottonwood Cr.
Murray
Midvale
Sandy
River
Jordan
Little Cottonwood Cr.
Dry Cottonwood Creek
Cr.
Draper
High Head Section
Willow
Cr.
28 Miles
91
Alpine – Draper Tunnel 2.85 Miles
Alpine
Fork
N
Deer Creek Reservoir
American
High Head Section
Deer Creek Dam
Dry Cr.
Lehi
American Fork
Pleasant Grove
Olmsted Tunnel 0.68 Miles
5.5 Miles
414' Tunnel
91
River
High Head Section
Utah
Lake
Provo
Provo

Fig. 1. Salt Lake Aqueduct, Provo River Project

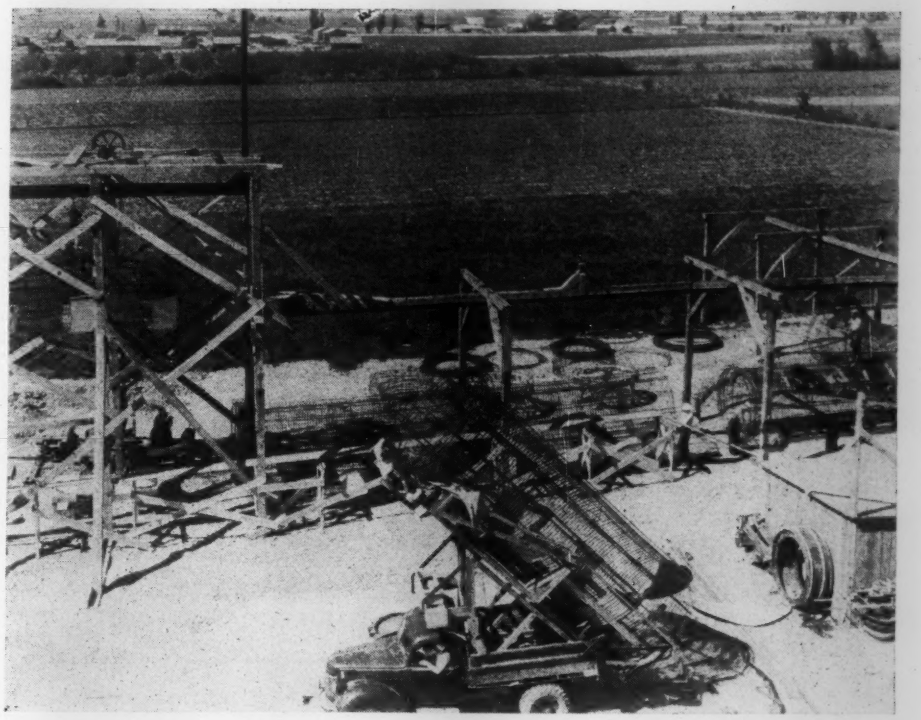
The Salt Lake Aqueduct will divert water from the outlet basin of the Deer Creek Dam at El. 5,276, extend down Provo River Canyon to the Olmsted tunnel, then proceed northwest toward Salt Lake City. Two former contracts providing for construction of the Olmsted and Alpine-Draper tunnels and one 9.1-mile section of pipe line from the Olmsted tunnel north to the American Fork Creek have been completed. The contract most recently completed called for $10^{1}/_{2}$ miles of low-head pipe line, consisting of a section in Provo Canyon, two short sections connecting the inlet and outlet portals of the Alpine-Draper tunnel, and two sections in Salt Lake County to as far north as Little Cottonwood Creek. Future contracts will include the uncompleted high-head sections across Big Cottonwood Creek and the remaining low-head portions in Provo Canyon and in Salt Lake County beyond Little Cottonwood Creek.

PIPE DESIGN AND MANUFACTURE

Design of the pipe line calls for reinforced concrete pipe units (bell-and-spigot type) with a $7^{1}/_{2}$-in. wall thickness and a rubber gasket seal at joints as assurance against leakage in case of movement from temperature changes or other slight disturbances. Outside grouting and inside mortar calking complete the joint. In field tests this joint has been tested under a longitudinal movement exceeding 1 in. without leakage.

The contractor for the recently completed sections, totaling $10^1/_2$ miles of low-head reinforced-concrete pipe, selected 20-ft lengths for casting. Plant operations included the following main units:

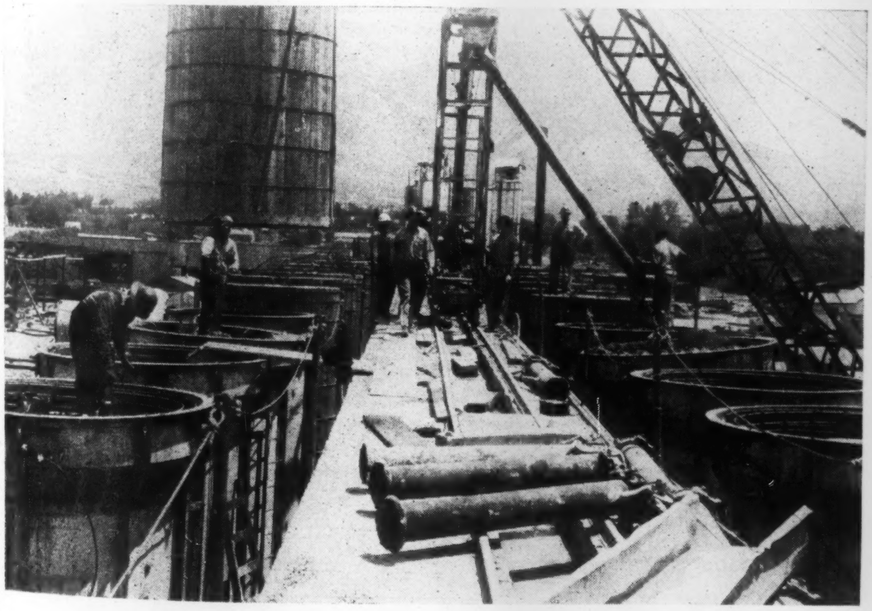
- Shop for handling, fabricating, and winding reinforcing steel for cages
- Yard for assembling, storing, and handling completed reinforcement cages
- Concrete batching and mixing plant, and Pumpcrete machine and line for concreting
- Steel forms, head rings, and pallet bases for casting 10 pipe sections daily
- Steam plant, lines, and wooden covers for curing pipe units to specified strengths before removal from casting bases
- Yard space and rollways for limited storage of pipe before removal to aqueduct line



ASSEMBLING AND TRANSPORTING STEEL CAGES FOR AQUEDUCT PIPE

After the steel bars were butt welded and tested, the reinforcement for the cages was wound, spaced, and tied on a specially built electrically driven mandrel, designed for the contractor and constructed at the plant shop. Steel was furnished in various sizes to meet specifications. Pipe units required for both horizontal and vertical curves were manufactured with the required deflection angle in the bell. Completed reinforcement cages were moved by small trailer to yard storage or directly to the forms as required. The placing of the cages in the forms was accomplished with a crawler-crane.

The casting of 20-ft lengths of pipe was made possible, in large measure, by rigid concrete control. Three-part aggregate (sand, $^3/_{16}$ to $^3/_4$-in., and $^3/_4$ to $1^1/_2$-in.) was trucked by the supplier four miles to the pipe plant and elevated to the batching-plant bins. A basic mix of 1 part cement, 2.25 parts sand, and 3.35 parts gravel (divided equally between $^3/_4$ and $1^1/_2$-in. sizes) was used. The mix was adjusted to compensate for small variations of significant undersize in the $^3/_4$-in. aggregate. An automatic batcher, with photoelectric-cell control prepared 1-cu yd charges.



CASTING PIPE OF 69-IN. DIAMETER—BATCHING AND MIXING PLANT IN BACKGROUND

Concrete was discharged into an agitation-hopper whence it was fed into a Pumpcrete machine for moving through a 7-in.-diameter pipe line to points of placement. The Pumpcrete line was mounted on a pouring trestle over 20 ft above the ground. A "discharge tower" near its terminus was equipped with a swivel "downspout" which could reach four pipe forms. In order to eliminate the tendency of the cement mortar to "hang up" on the reinforcing steel during the first part of the pour, two or three wheelbarrows of sand-cement grout were introduced into the forms to coat the steel at the beginning of each pipe pour. External electric vibrators mounted on the outside forms were used to consolidate the concrete in the forms.

CURING AND YARD HANDLING

On completion of the pour each pipe was covered with a wooden cover and steam curing was started. The specifications required a compression strength of 750 lb per sq in. before the forms were stripped. These strengths were obtained between pours in from 8 to 12 hours. After the forms were stripped, steam curing was continued to obtain specification strengths of 3,500 lb per sq in. before the pipe could be tipped and removed. No additional curing was required. Twenty-eight day strengths varied from 4,500 to 5,000 lb per sq in. Curing temperatures varied from 110 to 130 F.

LAYING A 69-IN.-DIAMETER PIPE SECTION WEIGHING 23 TONS, ON SALT LAKE AQUEDUCT

Completed pipe units were handled by a crawler-crane in the yard and were placed on pipe rollways, whence they were picked up by a truck-trailer for transportation to the aqueduct line. The trailer units were of the low-bed type (30 in. high), and the pipe units were either rolled off at their respective locations along the line trench or handled directly from the trailer for pipe-laying operations.

FIELD OPERATIONS

A roadway of sufficient width to accommodate excavation equipment was usually benched or roughed out with tractor-dozers prior to trenching. Trench excavation was then accomplished with a 3-cu yd dragline. Rock excavation, after blasting, was handled by a tractor-dozer to the benched roadway elevation and then with the regular excavation equipment. Bell-holes were excavated by hand labor just ahead of pipe-laying operations. Structure excavation was handled by machines except where space restrictions prohibited. All fine grading was done by hand labor.

Multi-wheeled semi-trailers were used by the contractor to haul and distribute the 23-ton pipe units along the aqueduct line. In nearly all cases the units were distributed well ahead of pipe-laying operations.

The 3-cu yd dragline used for trenching operations was also used as a crane to handle the pipe units for laying operations. Before a pipe unit was raised and lowered into place in the trench, a circular rubber gasket was placed in the gasket recess on the spigot end of the pipe. The gasket contained slightly less than sufficient volume to fill the gasket recess of the joint. After being lowered into the trench, each unit was supported by the crane while it was being joined to the preceding unit. Each successive unit was pulled into place by a portable hand winch, installed in previously laid pipe, pulling on a line attached to a backstay. The use of green soap (with a vegetable oil base) as a lubricant on the gasket and on all contact surfaces of the bell and spigot helped greatly to facilitate this operation.

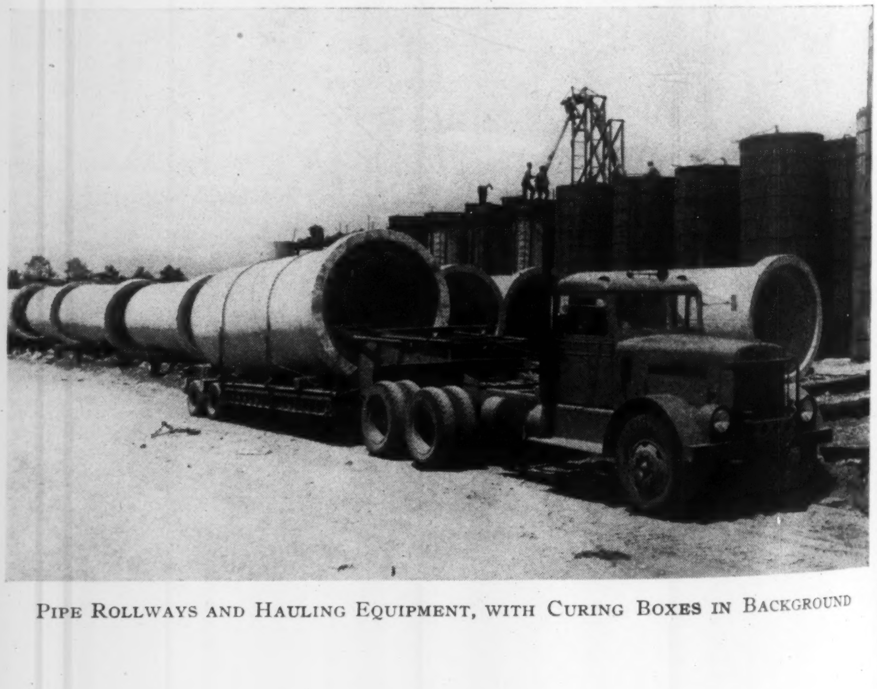
Placing of backfill, compacted to the springing line of the pipe, usually followed the laying operations, and then all remaining backfill and clean-up work were accomplished.

Tests made to date for leakage on completed sections of the line have disclosed an average loss in ten miles of 235 gal per mile in 24 hours. The maximum loss in one 1.7-mile section was found to be 500 gal per mile in 24 hours. The maximum leakage which was permitted by the specifications was 3,500 gal per mile over a 24-hour period.

During the latter part of November 1945, invitations for bids were released on the construction of $4^1/_2$ miles of high-head steel pipe line. Contracts for fabrication and for construction of this work were awarded in February 1946. These contracts include all high-head sections for the Salt Lake Aqueduct except the Big Cottonwood sections.

The construction program for the Provo River Project is being carried out by the Bureau of Reclamation under the general direction of the Denver office and the Regional Office, Region 4. Construction operations on the project are under the general charge of the writer as construction engineer.

The negotiated contract for the construction of the $10^1/_2$-mile section of the Salt Lake Aqueduct here described was held by Carl B. Warren, of Spokane, Wash., and the work was carried out under his general supervision. Work under the contract was completed in March 1946.



PIPE ROLLWAYS AND HAULING EQUIPMENT, WITH CURING BOXES IN BACKGROUND

Aims of a Curriculum for Civil Engineering Graduates

By WALLIS S. HAMILTON, ASSOC. M. ASCE
ASSISTANT PROFESSOR, CIVIL ENGINEERING DEPARTMENT, THE TECHNOLOGICAL INSTITUTE,
NORTHWESTERN UNIVERSITY, EVANSTON, ILL.

FORMULATION of a program for graduates in civil engineering at Northwestern University raised questions about the general objective of such extended training. Rather than depend entirely on academic judgment, Professor Hamilton sought the opinions of outstanding engineers in many fields of civil engineering, all active members of ASCE. Generally conceded to be of prime importance was the ability to design without detailed supervision.

THE primary purpose of a graduate program is to give the student additional working tools. Such tools come in an endless variety of sizes and shapes—some for specific jobs and others applicable to many different tasks. There is, for example, a catalog of implements that equip the five-year or six-year student to solve certain engineering problems beyond the ability of a four-year man. There are the instruments of law, politics, and social behavior; the tools of psychology, salesmanship, and business administration. Especially, there is the tool of concise and accurate expression, which most of us find so elusive. Thus, depending on the flexibility of the curriculum and his adviser, a graduate student in engineering may choose from a long list of courses designed to develop numerous abilities. How can the student and his adviser make a wise selection? What abilities are likely to prove good working tools for a civil engineer?

A student expects graduate study to increase both his beginning salary and his prospects for advancement. Moreover, when an employer pays more for a man with five or six years of training, he expects to receive someone more useful than a four-year student. Thus, if one is to evaluate working tools realistically, he must weight quite heavily the wants of prospective employers. There are, of course, numerous ways of determining these needs. For example, the student who works in industry during his undergraduate years may decide to remain with a particular organization, and if he plans graduate study he has an opportunity to find out directly what college courses are likely to be beneficial. Similarly, the man who comes to graduate school after a year or two of employment may have learned what he ought to study. Further, through consulting work, society discussions, and contacts with personnel men, an instructor can gage the needs of certain employers. Finally one may resort to the oft-abused and treacherous method of taking a poll.

Several months ago the writer mailed a questionnaire to a selected group of civil engineers who supervise or hire engineers. The sheet was accompanied by a letter explaining that a knowledge of the abilities supervisors consider essential in young engineers would be helpful in shaping a graduate program in civil engineering at Northwestern University. Criticism of the questionnaire and suggestions for additional essential abilities were invited. An attempt was made to send the letter and questionnaire to employers engaged in every subdivision of the civil engineering profession. Opinions were solicited from members of each committee in the ASCE Yearbook for 1944—men whose occupations, according to their titles in the Yearbook, were diversified, and men whom the writer knew to have broad interests and experience.

TABLE I. RELATIVE IMPORTANCE OP ABILITIES LISTED IN QUESTIONNAIRE

	ABILITY	AVERAGE ORDERS OF IMPORTANCE	% OF INDIFERENT VOTERS
(*k*)	Ability to design . . . without detailed supervision	2.3	10
(*f*)	Ability to make concise and accurate reports in good English, orally and in writing	2.6	0
(*m*)	Ability to apply theoretical approaches to engineering problems	3.9	21
(*l*)	Ability to solve simple engineering research problems experimentally	3.9	36
(*i*)	Ability to solve practical problems in fields allied to civil engineering	4.6	32
(*h*)	Ability to sell himself and products	5.2	40
(*e*)	Ability to analyze costs, keep accounts	5.7	35
(*n*)	Ability to solve relatively complex mathematical equations	7.2	62
(*c*)	Ability to attack the problem of regional planning intelligently	7.4	57
(*d*)	Ability to help arbitrate difficulties	7.6	59
(*a*)	Ability to appreciate and discuss to a limited extent cultural subjects	8.6	53
(*b*)	Ability to define the various forms of national government	9.4	59
(*j*)	Ability to describe modern synthetic materials	9.7	64
(*g*)	Ability to read technical literature in German and French	10.1	65

The response to this rather feeble attempt at a survey was unexpectedly vigorous. Everyone's opinions and suggestions have been correlated or organized into groups, and a summary of the results is given in the paragraphs that follow. Before presenting the answers, however, it might be wise to recognize some of the deficiencies of this particular poll.

To begin with, if one wants to determine a person's honest opinion on a particular matter, it is not fair to hand him a list of statements and ask him to choose a few—as was done in taking this poll. While the items before him may suddenly broaden his viewpoint of the subject, they may also obscure his personal convictions, and if he has little time to consider, he will make a choice before the new ideas merge with his own in the correct order of importance. Further, a busy person probably will choose a statement that comes fairly close to saying what he thinks instead of formulating a careful reply.

In the second place, the conclusions one draws from a study of all the individual replies are quite certain to be colored by the method of analysis. For example, some persons arranged all the abilities suggested on the questionnaire in order of importance, 1 through 14. Others divided the 14 abilities into three groups and labeled the groups one, two, and three; while still others either marked several items in order of importance or indicated that a particular half-dozen were equally desirable. Obviously more than one arithmetical way of weighting these heterogenous replies may be invented, and when a particular method makes a certain ability appear only slightly more important than the one next in line, the two had best be rated alike. Finally, only 84 questionnaires were mailed, from which about 80 replies were received. This group is too small to furnish representative data on abilities such as (*c*), (*d*), and (*e*), in Table I, which are important only to men doing specialized tasks.

In spite of these shortcomings, the questionnaire and letter elicited an appraisable reply from nearly all those to whom they were sent. The method of evaluation was as follows: For each ability, the number of votes for first, second, third . . . , fourteenth place were tabulated. When a questionnaire was marked to show that several abilities were of equal importance, a single vote for the indicated order of importance was divided among the abilities. Now suppose, for example, that a particular item received 10 votes for first place, 18 for second place, 12 for third, 12 for fourth, and 5 for fifth place—a total of 57 out of 80 replies.

Two useful facts are apparent: first, the centroid of the votes cast is somewhere between second and third place (actually at 2.7th place), and second, a certain percentage of the voters (in this case 28%) apparently did not consider the ability important enough to mention. These two facts can be considered indices of the desirability of the item, and hence the average order of importance, as indicated by the centroid of the votes, and the percentage of indifferent voters was computed for each ability. The results are shown in Table I.

Many persons found this list an inadequate medium for expressing their viewpoints and suggested other essentials of character and training, as well as thoughts that came to them while analyzing the matter of engineering education. The suggested essentials have been combined when two or more statements seemed to indicate the same desirable quality and are grouped under four headings in Table II. Within each group the items are listed in order of importance, as indicated by the number of persons who named the same essential and the emphasis each person placed upon it.

Most of the comments on engineering training had considerable bearing on graduate work; many of them corroborated opinions that have been expressed before. For example, two persons held that engineering will not receive recognition as a true profession until a period of training comparable to that required for doctors and lawyers is specified. This viewpoint is expressed by the following quotations: "I have long held the view that the engineering school should be essentially a graduate school to which a B.A. degree would be a requirement of entrance; . . . this requirement is of primary importance in the qualification of the engineering educators . . . . "

Again, the thesis of two others was that " . . . the objective of graduate work in engineering should be the development of leaders . . . failing in this it [graduate work] will not attract the students that would benefit most . . . . " One of them expressed the qualities needed for leadership as follows: "In engineering, leadership, assuming essential personality, will depend largely on ability to analyze, organize, and convince."

Finally, the discussions of several seemed to have common ground in the democratic principle that the student should study what he likes and is best fitted for. For example, one said that he would rate an ex-graduate primarily on his ability to perform research in his specialized field, while another pointed out that large companies do not need to employ broadly trained men. The latter felt that engineers are individualists and that specifications for them should be very flexible, especially specifications regarding cultural and supplementary subjects. A third expressed himself this way: "Permit me to suggest that what would appeal to the prospective employer might be the best for the first few years of the student's engineering life but might not be best in the long run . . . the student would be better off to confine himself to the division of engineering to which he is most fitted than to take up a division for which, at the moment, there is most demand."

TABLE II. QUALITIES CONSIDERED ESSENTIAL

Group A. Qualities of Character:
1. Basic fairness or intellectual honesty
2. Strength of character to stand by what is right
3. Loyalty to the purpose of his organization
4. Initiative, imagination, and inquiring mind
5. Willingness to use hands

Group B. Technical and Executive Qualifications:
1. Ability to analyze problems or situations and reach logical conclusions
2. Ability to organize an operation and push it through to a successful conclusion. This implies both resourcefulness and leadership
3. Ability to adapt thinking to new methods and materials
Ability to make a decent drawing with good lettering
4. Ability to use hands
Knowledge of construction materials
Knowledge of sources of technical information

Group C. Essentials Pertaining to Human Relations:
1. Ability to work and deal amicably with others
2. Ability to make concise and accurate reports that will be understood by non-engineers
3. Possession of a strong interest in engineering society affairs and community life
Ability to grasp and adjust divergent opinions resulting from different viewpoints
Ability to judge between true and false evidence, especially when the evidence is statements of individuals

Group D. Other Non-Technical Essentials:
1. Knowledge of economics and business administration
2. Habit of reading good literature and pursuing a hobby
3. Knowledge of elements of engineering and patent law

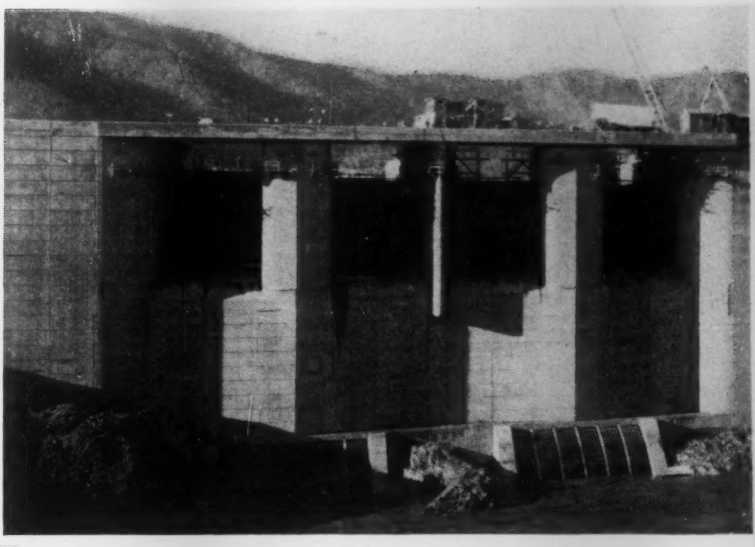
Judging by the returns from the questionnaire, teaching methods as well as curricula need revision. Both Table I and Table II, Group B, stress the need for young engineers who can be depended upon to carry out an assignment successfully. Hence, the development of responsibility, dependability, and initiative in students seems to need more emphasis than it now receives. Teachers have failed, also, to give the student enough criticized practice in self-expression. Every reply indicated that the ability to use good English is one of the most valuable possessions of an engineer.

This survey of mature engineers was made to obtain suggestions that might help formulate a postwar graduate program in civil engineering at Northwestern University. Perhaps it will be helpful, as well, to other groups interested in the matter of engineering education. The writer wishes to thank all those who contributed their considered opinions so generously and willingly. It is unfortunate that much of the force of their many fine letters had to be lost in the process of amalgamation.

Spillway Designed for Long-Range Savings

Part I of Symposium on Fontana Dam Spillway

By Adolf A. Meyer, M. ASCE
Chief, Civil and Architectural Design
Division, TVA, Knoxville, Tenn.



Upstream Face of Main Spillway

Unusual in many respects, the spillway for Fontana Dam on the Little Tennessee River is separated from the dam, with outlets tunneled through the rock abutment. Careful study of the hydraulic properties of the structure made possible smooth flow for all combinations of discharge. This article was adapted by Mr. Meyer from his part of a symposium presented before the Knoxville Sub-Section of the Tennessee Valley Section. Descriptions of spillway construction and model studies will appear in succeeding issues.

Urgent demand for increasing amounts of electric power to be used for war production called for a fast construction program at the TVA's Fontana Dam. The required speed was entirely unprecedented for a dam of its size. Based on project quantities, a period of from five to six years would normally have been considered necessary for construction. War requirements made it imperative to cut this time to three years. The project was authorized in January 1942, a short time after Pearl Harbor. Filling of the reservoir was started in November 1944. The first power was generated during January 1945.

The general project layout and its objectives were described in an earlier article by the writer and Calvin V. Davis (July 1943, Civil Engineering). In this article it was pointed out that the war schedule required all features tending to impede rapid progress on the main dam to be eliminated wherever feasible. With its concrete volume of 2,700,000 cu yd, the dam was the dominant element in the construction planning. It was obvious from the start that it had to be built in a single construction stage. This meant that tunnels had to be excavated for diversion of the river around the construction area. To facilitate large-scale, mass production, it was desirable to obtain the greatest possible number of uniform construction elements. Therefore the conventional arrangement, which integrates sluices and spillway with the main dam, was considered inexpedient. Several studies with alternative locations of these features were made.

These studies showed that a satisfactory and economical overall arrangement could be obtained by making permanent use of the tunnels built for diversion during construction. This layout showed many added advantages in the disposition of the power facilities. However, the proposed spillway arrangement included many unusual features from both the hydraulic and the structural points of view. To obtain a satisfactory layout, it was essential to make a careful study of the hydraulic phenomena involved and then to incorporate the conclusions carefully both in the design and in the actual construction. This called for the closest cooperation between the design office, the hydraulic laboratory, and the construction staff.

By moving the zone of energy dissipation away from the toe of the dam, where scouring would have affected the safety of the structure, the problem of scouring could be approached from an entirely different angle. It could be detached from the extremely conservative assumptions used for the design flood. It could be moved into the sphere of economics, where the cost of protection for releases of definite probabilities could be evaluated against possible future maintenance costs for still larger releases of very remote probabilities.

The outlet works are designed for a maximum discharge of 199,000 cu ft

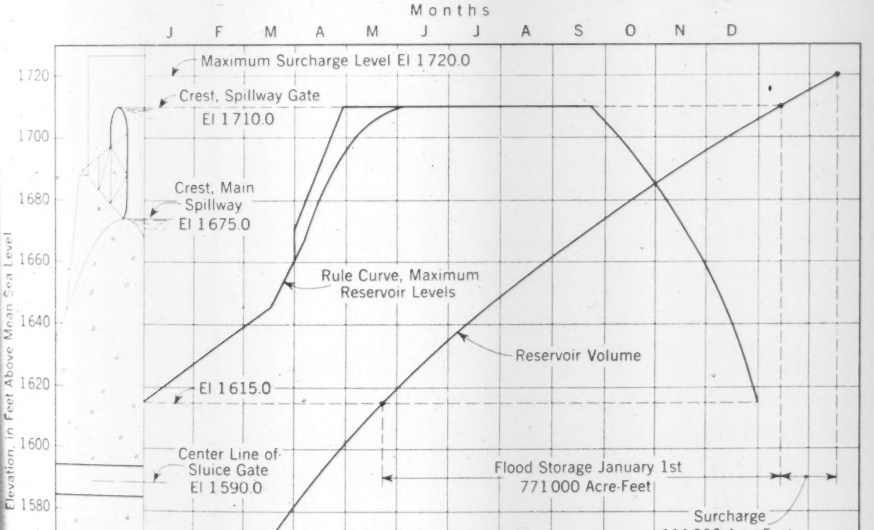


Fig. 1. Reservoir Volume and "Rule" Curve for Fontana Spillway

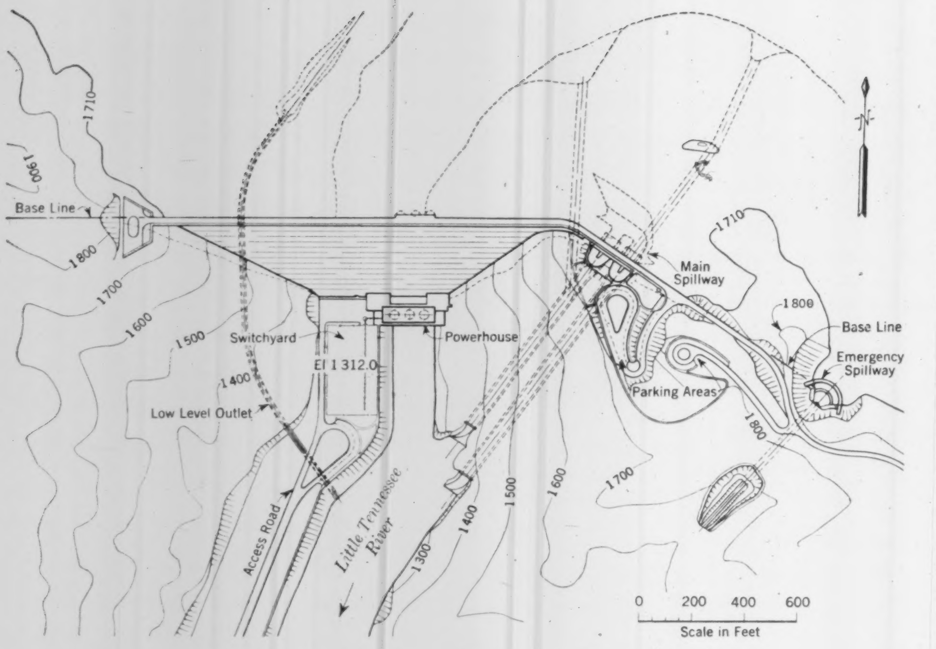


FIG. 2. GENERAL SITE PLAN OF FONTANA DAM

per sec. This outflow intensity was established by routing the design flood through the reservoir, assuming that the reservoir would be filled to the maximum controlled level at the start of the flood. The design flood, conservatively selected from storm and runoff studies, has a total volume of 840,000 acre-ft, with a peak inflow of 239,000 cu ft per sec.

The large spillway capacity arrived at when starting from these very severe assumptions will protect the integrity of the critically important dam structure during any freak storm centered squarely on the drainage area. But within practical probabilities, the expected flood-water releases from the reservoir are of an entirely different order of magnitude. Normal flood inflows will be absorbed in reservoir storage. To provide storage volume for flood control operation, a minimum amount of flood storage volume, varying in proportion to the seasonal flood probabilities, is to be maintained. Figure 1 shows the adopted "rule curve" and the reservoir volume curve for Fontana. By January 1 of each year, the reservoir level has to be at El. 1615 or lower. At that time, the available flood storage, including surcharge storage, will be at least 882,000 acre-ft. It is well to notice that this minimum storage stipulated by the "rule curve" exceeds the total volume of the tremendously large design flood. Toward the end of the major general flood season, the margin for flood storage is gradually reduced. During early summer, only the surcharge volume between Els. 1710 and 1720 is available at all times. But even this volume amounts to 110,000 acre-ft.

The function of the spillway can now be easily appraised. During years with average or below-average flow, it will not have to release any water at all. The units in the power house will then draw all the available flow unless we assume that there is no demand for power. During the reservoir filling season of a wet year, releases will have to be made to maintain the stipulated flood-storage margin. These discharges will have to be made through the sluices, and their magnitude is therefore limited by the total capacity of all the sluices, which is 24,000 cu ft per sec at full reservoir.

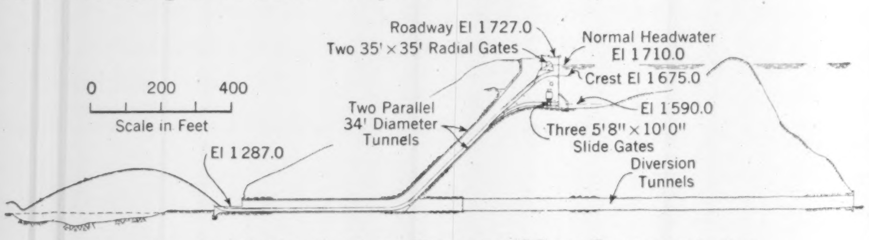

Roadway El 1 727.0
Two 35' × 35' Radial Gates
Normal Headwater El 1 710.0
Crest El 1 675.0
El 1 590.0
0 200 400
Scale in Feet
Two Parallel 34' Diameter Tunnels
Three 5'8" × 10'0" Slide Gates
El 1 287.0
Diversion Tunnels

FIG. 3. CROSS SECTION THROUGH MAIN SPILLWAY, WITH FLOW OF 25,000 CU FT PER SEC INDICATED

If a flood inflow of the intensity of the maximum recorded flood should occur very late in the filling season, or during the summer when the reservoir may be filled to maximum operating level, a discharge larger than the sluice capacity will be required. A maximum release of about 50,000 cu ft per sec may be necessary under such conditions, or 26,000 cu ft per sec beyond the capacity of the sluices.

Beyond these discharges which have a practical probability, the design provides for a total release of 199,000 cu ft per sec through all outlet structures, as a safety valve to provide against that most improbable day when the design flood inflow might find the reservoir filled.

The outlet works consist of three entirely different groups of structures, all removed from the main dam. The low-level outlet utilizes a railroad tunnel which was built to bypass the construction area (Fig. 2). It was converted into a hydraulic outlet mainly to obtain a means of river control during the initial filling of the reservoir, which had to be done during a period of urgent power demand for war production. This outlet is controlled by an 84-in. Howell-Bunger valve, with an emergency sliding gate 5 ft 8 in. by 10 ft placed upstream of the valve. The control works are set into the tunnel plug, located below the heel of the dam.

Along the rocky crest to the left of the main dam is the emergency spillway, which provides a fixed overfall weir 178 ft long, over which water will start discharging whenever the reservoir reaches El. 1715 during surcharge operations. This emergency spillway is formed by an arch dam 55 ft high, with a cushion pool immediately back of the arch. The discharge flows through a short tunnel into a gully, which leads the water to the main river.

By far the most important group of structures in the outlet works makes up the main spillway, which is the subject of this symposium. Of the total maximum discharge capacity of 199,000 cu ft per sec assumed for the project design, the main spillway is assigned to carry 182,000 cu ft per sec.

As already mentioned, the spillway utilizes the tunnels built for diversion during construction. Diversion required two unlined tunnels with a nominal bore 38 ft in diameter. Both tunnels were located under the ridge forming the left abutment, where the shortest length could be obtained for a bypass around the construction area. Because the top of this ridge is below reservoir level for a distance of about 700 ft, this gap had to be closed by a secondary dam about 100 ft high. It appeared desirable from the start to integrate the inlet for the spillway with this part of the dam. The discharge ends of the tunnels were located at right angles to the dam above. By this arrangement a straight horizontal alinement of the spillway conduit was obtained. Shafts built on a 1 to 1 slope connect the tunnels with the inlet structures at the dam. The 45° elbow, the only bend in the conduit, is built to a 100-ft radius. The relation between the diversion tunnels and the ridge dam above is shown in Fig. 3.

Like the diversion tunnels, the lower portions of the shafts were built to a bore of 38-ft diameter. The permanent parts of the conduits were then lined with concrete to a section 34 ft in diameter. From El. 1482.7 up, each shaft gradually funnels into a much wider section. The control for the capacity of the conduit is therefore at El. 1482.7. Because all flow accelerations act essentially in the direction of the shaft, the available conduit areas are utilized with good hydraulic efficiency. At maximum discharge, there remains a margin of about one-sixth of the section area to allow for an increase in the jet thickness caused by air entrainment.

At the head of each of the large funnels (Fig. 4) are the control gates. They are two 35 by 35-ft radial gates, with their tops at El. 1710. The gates are designed to be overtopped in case this should prove desirable during surcharge operations. Stationary hoists on the machinery deck above are set to raise and lower the pair of gates ahead of each tunnel in synchronism at all times.

A distance of 120 ft below the top of the gates are the centers of the 5-ft 8-in. by 10-ft sluices. Three such sluices connect to each tunnel. To build them, a rock cut about 40 ft deep had to be excavated on the center line of each tunnel, connecting to the bottom of the gully upstream from the spillway. Controls and details of the sluices follow the practice successfully established on previous TVA storage dams. An arch-shaped trash structure with ample area protects the entrance. Short bellmouths guide the water into the sluices proper. Two hydraulically operated slide gates, arranged in tandem, control the flow through each conduit. At the discharge end, the cross section is reduced by 10% to establish conservative positive pressures throughout the sluice for all discharge conditions as a safeguard against cavitation.

At the head of each shaft, the top of sound rock was about 100 ft below the ground surface. It was essential that all slopes around this large excavation pit be stable, as any slides into the tunnel during discharges might be disastrous for the concrete lining. The most positive protection, a concrete cover over the full length of the funnel, was adopted after several alternatives had been studied. The conical arch which forms the cover reaches a span of 74 ft at its upper end.

The lining in the circular tunnel, through which water passes with tremendous velocities, up to 150 ft per sec, had to be of great uniformity and smoothness. Rough irregularities would produce low-pressure zones, conducive to cavitation. But the lining of a tunnel 34 ft in diameter necessarily requires some tolerances on the accuracy of the forms. Studies were made at the Hydraulic Laboratory in an effort to establish safe limits for these irregularities.

Where the tunnel lining joins the closure plug in the diversion tunnel, closure-plug operations and tunnel lining were strictly separated at Fontana. The plug was so located that after it had been placed, cooled, and grouted, space was available to place the lining in accordance with the standard procedure used elsewhere in the tunnels.

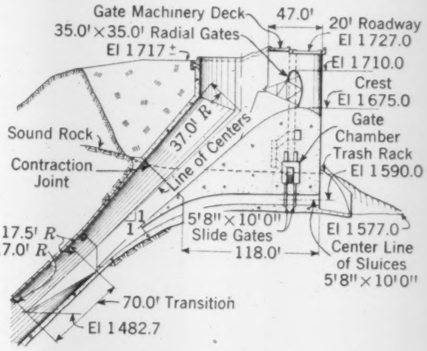


Fig. 4. Head Structure of Main Spillway

ENERGY DISSIPATION

The most interesting feature of the spillway—and without doubt the most spectacular one—is the energy-dissipating arrangement downstream from the discharge end of the tunnels. Concrete buckets adjacent to the portals lift the fast-moving water up into the air and direct the jets diagonally across the river basin. The buckets and the outline of the river basin were shaped from tests in the Hydraulic Laboratory, which will be described in a later article. The adopted arrangement gives stable conditions in the river basin at low cost, for the full range of probable water releases. However, this stable condition will only be obtained after the first wet year has allowed enough discharges to thoroughly scour the floor of the dissipating basin.

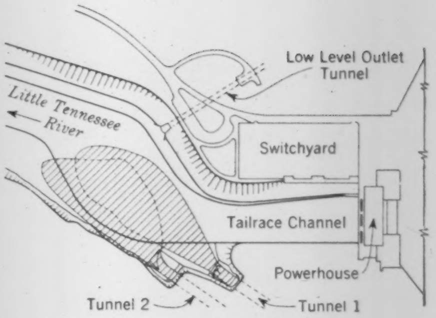


Fig. 5. Discharge Jet Patterns, for a Discharge per Tunnel of 25,000 Cu Ft per Sec

CHANNEL EROSION PATTERN

Laboratory tests indicate that a stable floor for all flows up to 50,000 cu ft per sec will be reached after about 60,000 cu yd of rock have been eroded and moved downstream. From a prototype test made in June 1945, we know that erosion of the rock will proceed at a rather fast rate. This material will be deposited in the river channel below and will impede the discharge from the tailrace. It is planned to use the first opportunity to obtain the final erosion pattern for this range of flows, and then to remove the loose material in one operation, which can be carried out in the dry during an outage period of the units. After this removal, the dissipating basin should remain unchanged. The fill slopes, which are exposed to heavy wave action during discharge, are protected by heavy riprap containing stones with specified weights up to six tons. The foot of the riprapped slope is stabilized by a concrete toe-wall.

The jet patterns for a discharge of 25,000 cu ft per sec per tunnel are indicated in section and in plan on Figs. 3 and 5. If a flow release above 50,000 cu ft per sec should ever have to be made, additional scouring in the river bottom and damage to the fill slopes of the basin would have to be expected. The possibility of future maintenance charges therefore has to be taken into consideration. A comparison of this liability of the present layout with the increased capital charges which the construction of a conventional stilling basin would have involved, however, indicates that very substantial long-range savings will result from this unusual arrangement for energy dissipation.

Reconstruction of Manila Harbor

By MARTIN M. GROSS

SECOND LIEUTENANT, CORPS OF ENGINEERS, U.S.A.

RETURNING to Manila, American military forces faced a seemingly insuperable task of clearing wreckage from the harbor and rebuilding port facilities. That the work was done has long been apparent to "the folks at home," for advancing forces paused but momentarily in their march to victory. However, only recently have details of the port reconstruction, as here related by Lieutenant Gross, been released for publication.

"WE'RE going back to Manila!" These were the words that burned brightly in the writer's mind when he came away from his first meeting with a planning group that had been set up at the Sixth Army Headquarters in New Guinea. This meeting took place in September 1944. During the months of planning that followed, the use of Manila as a launching site for the final assault against Japan was continually stressed. Of primary importance, therefore, was the rehabilitation and further development of Manila's excellent harbor and port potentialities.

All records, intelligence studies, and pictures then available were collected in order to familiarize every member of the planning group with the prewar condition of Manila Harbor. Aerial reconnaissance, made immediately after each large-scale bombing, kept the group abreast of new damage.

We had expected to rebuild at least 75% of the existing port facilities, besides adding another 100%. When the first reconnaissance party reached Manila Harbor after our return in February 1945, we were prepared for the worst, yet even in our wildest imaginings we could not have pictured the holocaust that met our eyes.

Strewn throughout the harbor were the hulks of some 700 vessels of all types and sizes, some barely visible. The piers seemed at first to be nothing but a mass of twisted steel and rubble. Here indeed was a problem to test American ingenuity and engineering skill. In order to fully understand the tremendous task confronting the engineers assigned the job of reconstruction, more should be known about the port itself, as it was before the war.

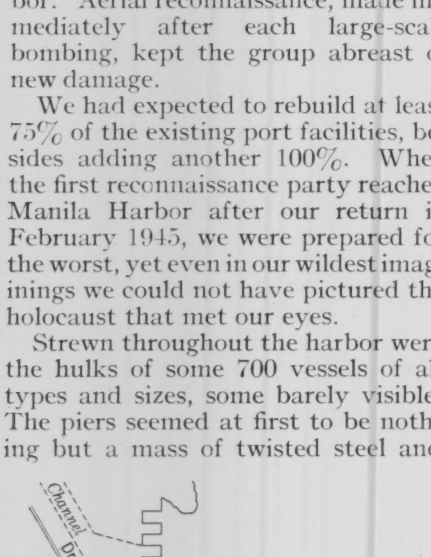


FIG. 1. PORT OF MANILA

THE PORT OF MANILA

The port of Manila is on the eastern shore of Manila Bay, one of the finest natural harbors in the Orient, having a total area of 700 sq miles and a circumference of 120 miles. The port (Fig. 1) comprises the South and North harbors, and the lower part of the Pasig River (below Jones Bridge). These are known as the inner harbor. The outer harbor, which is outside the breakwater, was used as a quarantine and fleet anchorage.

South Harbor, the main harbor of Manila, is south of the Pasig River and comprises an anchorage water area of about 1,250 acres, partly inclosed and well protected by a rock breakwater. The entrance to this harbor was through a channel having a controlling depth of 32 ft. This led through a 500-ft gap between the west and south breakwaters, and thence directly to the wharves opposite the entrance. A depth of 34 ft. in the channel and deep-water anchorage area was maintained by constant dredging. The piers and wharves occupied the north part of the waterfront. Between the north end of South Harbor and the canal leading into the Pasig River, there was a small marine basin about 300 yd square, known as the "Inner Basin." It was used mainly by small craft and vessels under repair. A breakwater partly separates it from the north end of the South Harbor.

Pasig River divides Manila into two parts and serves as an arterial waterway from the city to Laguna de Bay. The entrance to the river had a dredged depth of 18 ft on the bar at low water, and the river had similar depths as far as the Jones Bridge, about 4,000 ft from the entrance mouth, but it was continually shoaling. The banks below the Jones Bridge had been quayed for use by inter-island shipping, and above it were numerous quays and wharves for lighters, small boats, and steamers plying the river between Manila and Laguna de Bay.

NEW NORTH HARBOR

The new North Harbor lies north of the Pasig River. Extending in a northwesterly direction from the river for about 6,500 ft, it was nearly completed when the Japanese came. The harbor then covered a water area of over 1,000 acres and a reclaimed land area between the piers and the original shoreline of about 600 acres. At the time of the occupation, the completed land area amounted to about 200 acres, and five of the eight piers under construction had been filled with dredged material. The Japanese did no further work on the uncompleted piers.

FACILITIES IN SOUTH HARBOR

The facilities in South Harbor consisted of four piers with 11 berths, totaling approximately 6,700 lin ft, for the use of overseas shipping; and two wharves for coastal and light-draft vessels, totaling 1,100 lin ft. The four piers included Pier 1; Wharf B and Piers 3 and 5, used by overseas shipping; and the new Pier 7, one of the finest piers in existence prior to the war. The facilities in South Harbor, with the exception of Wharf B, were rendered entirely useless.

Completely equipped with modern cargo-handling facilities, Pier 7 had been capable of accommodating six Liberty-sized vessels. This pier had a reinforced concrete slab-and-girder type deck on 24-in. square concrete piles. The walls and columns of the transit shed were concrete and its roof was galvanized iron on steel roof trusses.

Piers 5, 3, and 1, lying north of Pier 7 in the order named, were constructed of reinforced concrete on structural steel framework, resting on concrete-filled steel cylinders and timber piling foundations. The aprons were reinforced concrete on concrete piles surfaced with creosote blocks. Transit sheds were structural-steel frame covered with corrugated-iron roofs and siding.

Wharf A was an open masonry quay that had no cargo shed. It was used for handling heavy cargo. Wharf B, practically untouched, had been used for coastal trade and had a reinforced concrete slab-and-girder deck, supported by a concrete gravity wall and pilaster and timber pile subfoundation. The transit shed, which occupies the entire length of the wharf, had reinforced concrete walls, steel roof trusses, and a galvanized-iron roof.

In North Harbor, the five piers that were filled with dredged material were approximately 725 ft long by 250 ft wide, separated by slips 450 ft wide. Dredging alongside these piers had been neglected during the Japanese occupation and a depth of over 10 ft in slips and alongside piers was not expected.

PROBLEMS OF REHABILITATION

The effort necessary to make Manila a first-class port, capable of meeting our exceedingly heavy wartime shipping requirements, can be divided into four essential parts:

1. Ship salvage, which consisted of the removal of all sunken craft that interfered with the use of existing and new berths and channel entrance and anchorage facilities.
2. Construction of emergency landings for LST's, LSM's, LCT's, and LCM's.
3. Pier construction and rehabilitation, which meant the complete repair of the four existing piers, with extensions added to three of them; the construction of four additional piers in South Harbor; and filling and hardstanding the five piers in North Harbor.
4. Dredging, comprising the removal of some 4,000,000 cu yd of material in North and South harbors and in the Pasig River.

SHIP SALVAGE

The first chore for the engineers, after the occupation of Manila by our forces, was to take complete soundings of the North and South harbors and chart the wrecks. This job was considerably hampered by Japanese snipers, imbued with Shintoism, who had boarded the partially submerged wrecks and were making a last-ditch stand. After several sharp skirmishes between survey parties engaged in the work and the snipers, the latter were completely eliminated by amphibious engineers of the 4th Engineer Special Brigade, who boarded the wrecks armed with flame throwers and small arms.

Aerial View of Manila Harbor After Reconstruction

With the completion of the harbor charts a definite course of action could be laid out. Highest priority was given to the removal of sunken vessels blocking the entrance to South Harbor and wrecks around the existing piers that would forestall berthing once these piers had been repaired. Under intermittent sniper fire, an Engineer Port Construction and Repair group, an Engineer Aviation Battalion, and approximately 1,000 civilians began the tasks of removing the wreckage and debris, making emergency repairs on existing South Harbor piers, and constructing LST and LCM landings.

SALVAGE OPERATIONS

Salvage operations were undertaken by a Naval Salvage Group under the command of Commodore William A. Sullivan, U.S. Naval Salvage expert, who had supervised the clearing of Salerno and Cherbourg harbors in the European Theater of Operations. Because of the complicated nature of the salvage operations, they cannot be treated in detail here.

The need for landing beaches for LST's, LCT's, and LCM's that were bringing troops from new areas and lightering supplies from vessels at anchorage became acute. The concrete walls in Slips 2 and 4, North Harbor, and between Piers 1 and 3, South Harbor, were demolished and a beach created by dumping rubble fill (so readily obtainable anywhere in the city) out to a sufficient depth. The beach in South Harbor was used for the larger landing craft, such as LST's and LSM's and the beach in North Harbor for the smaller craft.

PIER CONSTRUCTION AND REHABILITATION

Pier 7, the first to be reconstructed, was breached in three places, across the entire width of the pier, and had several smaller breached sections in the aprons and center portions. At each of these breaches the superstructure of the transit shed was completely collapsed, presenting an impassable mass of steel and rubble. In addition, prepared Japanese demolitions had blown many supporting columns, leaving the trusses hanging dangerously from adjoining columns and creating a definite hazard to any work that might be undertaken.

As a result of our precision bombing, only one Liberty berth on the North side of the pier was not blocked by sunken vessels. In order to make this one berth available in as short a time as possible, it was decided to clear the wreckage and debris from the aprons and span the breaches with Bailey bridging in order to allow one-way traffic completely around the pier. Before this could be done, the partially collapsed sections of the superstructure were completely removed by prepared demolitions and considerable cutting and burning, and unsupported truss members that were not considered obstructive were shored and braced.

TWISTED REMAINS OF PORT FACILITIES FOUND BY THE ENGINEERS

Four single-double Bailey bridges and two single-single ones, each 40 to 50 ft long, were used to span the breaches in the aprons. With the aprons cleared sufficiently to allow single-lane traffic completely around the pier, maximum effort was concentrated on clearing the center portion. The breaches were then repaired in the following manner.

METHOD OF BREACH REPAIR

All debris was completely removed from a breach. Divers were sent down to check any remaining piles that seemed usable. After a thorough examination, all loose concrete and reinforcing were removed from a usable pile and a square surface obtained by chipping with pneumatic hammers. Reinforcing rods were then spliced to the existing steel, and concrete was poured to bring the pile up to grade. A standard pile bent, with piles spaced 5 ft on centers, was then driven along the edge of the breach and capped immediately. At each concrete pile that had been destroyed or damaged beyond repair, four wooden piles were driven on a batter straddling the destroyed pile, and tied as a cluster at the top (Fig. 2). A billet plate was then drifted to this cluster. Steel beams were placed parallel to the longitudinal axis of the dock from the bent along the near edge of the breach, along a row of piles to the bent immediately next to the far edge. Caps were bolted to these beams and then stringers and decking placed according to standard practice.

When the necessary repairs on the center part of the pier were completed, a Bailey bridge spanning a breach in the apron was removed and the breach repaired (using the same method that was employed in the repair of the center portion), then the second Bailey was removed and the breach repaired, thereby limiting the obstruction on that part of the pier to the maximum of one hold per Liberty berth at one time. The smaller bomb holes were repaired by hanging forms from bents at each side of the breach and pouring concrete in standard flat-slab design. Work was begun on this pier March 3, and the first Liberty berth was available on March 15, 1945.

The next assignment in South Harbor was Pier 5, which was approximately 650 ft long by 165 ft wide. It had been breached in three places similar to Pier 7, and the transit shed was in such a state that it was felt advisable to remove it entirely. Because of the similarity of conditions at Piers 5 and 7, it was thought advisable to use the same approach, that is, to open up the aprons immediately to single-lane traffic and add the extension before attempting complete repair. Clearing the aprons was accomplished with the aid of heavy-lift floating cranes and barges from the water side, and large crawler-type cranes and trucks working from the top of the dock. The inshore apron breaches were cleared and any usable existing piles were cut down so that they contained no defective concrete, and then built back up to grade. Creosoted timber piles were driven to take the place of those destroyed; then caps, stringers, and decking were placed as in standard dock-construction practice. The extension was a standard theater-of-operations timber-pile dock, 300 ft long and the same width as the original piers. All bearing piles in the extension had to be spliced to 120-ft lengths, the bottom of Manila Bay being covered with a 20-ft depth of soupy silt brought down by Pasig River. The splicing ways were adjacent to the construction site and caused the diversion of two companies of the Aviation Battalion and many additional civilians. Work was begun on this pier on March 12, and it was turned over to the using agency on May 17, 1945.

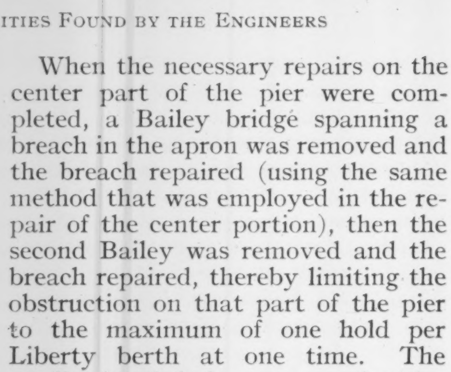


FIG. 2. TIMBER PILES REPLACED BROKEN CONCRETE IN PIER RECONSTRUCTION

OTHER PIERS REPAIRED

Pier 3, which was 600 ft long by 115 ft wide, was breached in exactly the same fashion as Pier 5, and here again the same method was used of removing the transit shed and repairing and extending the pier, the extension in this case being 425 ft long. Work was started on this pier on March 12 and turned over on May 11, 1945.

In the case of both Piers 3 and 5, the center portion could only be used for cargo in transit, and its immediate use was not considered of primary importance. These repairs have since been made.

Pier 1 was breached completely through in two places and had two large bomb holes at the seaward end. The breaches were repaired by the same methods employed in repairing Piers 3 and 5, except that each breach was completely repaired initially. Bomb holes were repaired in the same fashion as those on the other piers. Work on this pier was started May 20 and completed July 10, 1945.

Construction of two finger-type pile docks, each 450 ft long by 88 ft wide, was started the fifteenth of May. One was between Piers 3 and 5. The design was standard theater-of-operations type except that batter piles were added at the outside of each bent in order to give additional stability during typhoons. These piers were completed in approximately five weeks.

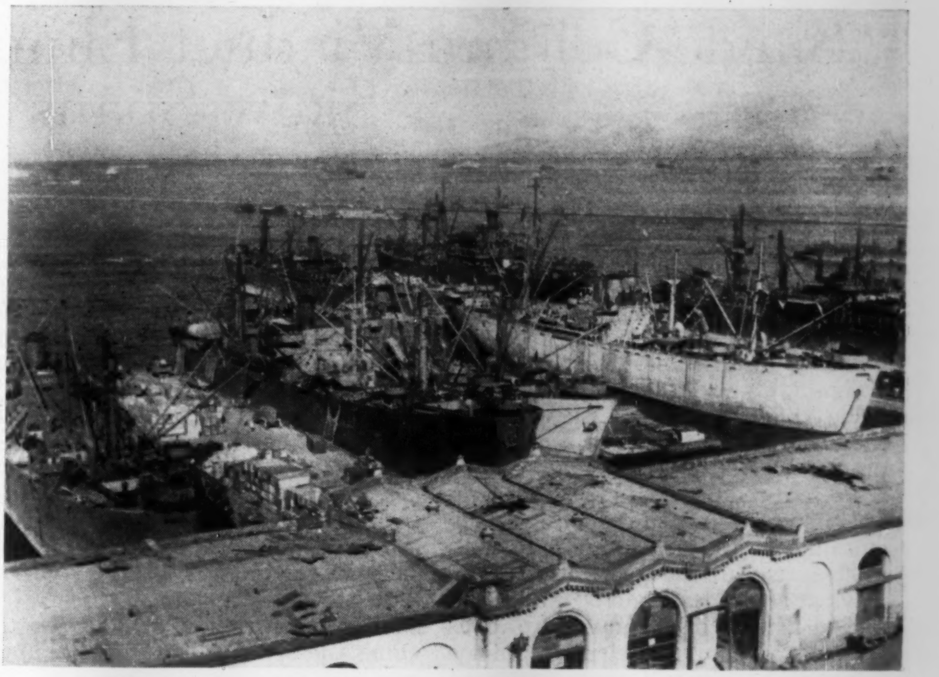
FLOATING PIERS

Two floating Navy ponton cube docks were installed, one north of Pier 1 and one south of Pier 7. These docks were made up of five 16 by 18 cube barges joined together with standard hinge assemblies. An unusual innovation in their design was the use of two single-double Bailey bridges 70 ft long as approaches. The Baileys were anchored at the abutment end and rode free on a greased "slide plate" at the pier end, a method that considerably expedited construction by eliminating the usual pile approach. The first pier was completely installed in eight days and the second in five.

In North Harbor the entire construction program consisted of hardstanding the five filled piers and laying double railroad tracks along each side from a classification yard out to the end of each pier. This work was carried out by working on only one-third of the pier at a time so that the suspension of cargo-handling operations could be held to a minimum. No construction work was necessary along the quays in the Pasig River as they had sustained very little damage, if any. The major task here was the clearing of the rubble and debris from the ruined buildings back of the quays, which presented no unusual engineering problems.

DREDGING GIVEN A HIGH PRIORITY

The dredging necessary to open a channel in the North Harbor and the Pasig River ranked high in priority. With the entry of our forces into the city, we immediately set out to determine the availability of several dredges formerly used by the city's Bureau of Public Works. After a thorough inspection (aided by the Bureau's former employees), we found that not one of the six dredges formerly in use could be repaired and placed in operation. Dredges already in use in rear areas had previously been ordered forward, and the first to arrive was a 700-cu yd hopper type which immediately began dredging the North Harbor channel. This channel was 400 ft wide and paralleled the breakwater some 400 ft away from its inshore edge. This channel was completed on April 19, when the dredge moved to the Pasig River and began digging the entrance channel.



Port Was Put in Service Before Debris Could Be Entirely Removed

MINE CAUSES DELAY

The next two dredges to arrive were pipe-line dredges and they were put to work on the slips in the North Harbor. Unfortunately the Liberty ship carrying the floating line for the larger of these two dredges struck a mine on entering the harbor. While this did not cause any damage to the pipe, it entailed considerable delay in its removal and in the subsequent operation of the dredge. The dredging in the first three slips was completed about the end of May, but all the North Harbor piers had been in use by lighters and barges ever since the opening of the channel. The dredging enabled coastwise vessels and lightly loaded Liberties to make use of these additional facilities.

In South Harbor the dredging was done by a 1,400-cu yd dredge of the hopper type. A 30-ft contour from the President's Landing (some 1,000 ft south of Pier 7) to the northern end of the south breakwater was established as the southern boundary. The west breakwater and the shore line behind the existing piers and the Inner Basin defined the other boundaries. The material to be removed consisted of a large shoal abutting and paralleling the west breakwater, and of smaller shoals around each of the piers at the shore line. Some 1,200,000 cu yd have been removed from the South Harbor to date. The spoil area is located in the outer harbor some $6^1/_2$ miles from the breakwater entrance.

Dredging in the Pasig River was considerably hampered by an extremely hard sand bar at the river's mouth, by many submarine telephone and telegraph cables crossing the river, and by the constant flow of river traffic, which could not be interrupted. The sand bar at the mouth of the river was removed by a hydraulic dredge. The cables were jetted down to sufficient depth by divers so as not to interfere with dredging operations, and the dredge made long single passes along the whole length of the channel so as not to interfere with river traffic.

THE PORT IS WORKING

Today the Port of Manila stands rebuilt to meet our present requirements, a living monument to the ability of the Army Engineers. Though it lacks the sumptuous accessories vital to a peacetime port, such as elaborate cargo-handling facilities, customs and regulating buildings, and many other "comforts," it is doing its job, which is all that had been required. The daily tonnage being handled exceeds even the most optimistic estimates.

The greatest credit for this notable achievement must be given to the Engineer soldier, whose grit, determination, and indefatigable efforts prepared this port to be one of the main platforms for launching our final assault against Japan, and makes it now a base capable of handling our future needs.

Single-Column Viaduct Eliminates Need for Skew Spans

By R. W. Finke, M. ASCE

Bridge Engineer, Washington State Department of Highways, Olympia, Wash.

Equal span lengths, elimination of skew, and economy of materials are advantages of the design used by the Washington State Highway Department for its Union Gap Overcrossing. Each section of the structure between expansion joints is a rigid frame utilizing the supporting columns in distributing stress. As the author points out, the rapidity with which construction proceeded, in spite of difficult wartime conditions, indicates definite construction advantages in this type.

In his book, *Bridge Engineering*, the late J. A. L. Waddell, M. ASCE, one of the eminent authorities of his day on bridge engineering, includes in his "first principles of designing" the following statement: "The building of a skew-bridge should always be avoided when it is practicable."

Present requirements for alinement on highways and superhighways inevitably necessitate many crossings of streams, railroads, and other highways at angles less than 90°, and it is indeed rare to discover a right-angle crossing on any modern highway location. As a result, more and more skewed bridges are being constructed, not entirely because of a disregard for Mr. Waddell's sage advice, but because there are fewer cases in which it seems practicable to avoid them. The usual and obvious ways in which to avoid skewing a bridge, and those mentioned by Mr. Waddell in his text, are often less practicable than a skewed design, and in many cases such a design is adopted as the only obvious alternative.

SINGLE-COLUMN SOLUTION

There are, of course, many instances in which a skewed bridge is the only reasonable answer to a bridge problem, and if proper care is taken in its design and construction a good structure will result. However, many skewed bridges have not performed satisfactorily and it is still good practice to avoid them when practicable.

The problem, then, is to devise some means for the elimination of skewed construction without lengthening the span or shifting the alinement. A very good solution to this problem in certain cases is the adoption of a pier or bent design having a single column on the centerline of the structure in place of the conventional design having two or more columns.

As far as it is known by the writer, the Connecticut State Highway Department in its Housatonic River crossing was the first to use this type of pier in recent times. It is believed, however, that a similar design has previously been employed for another purpose in elevated railroad construction.

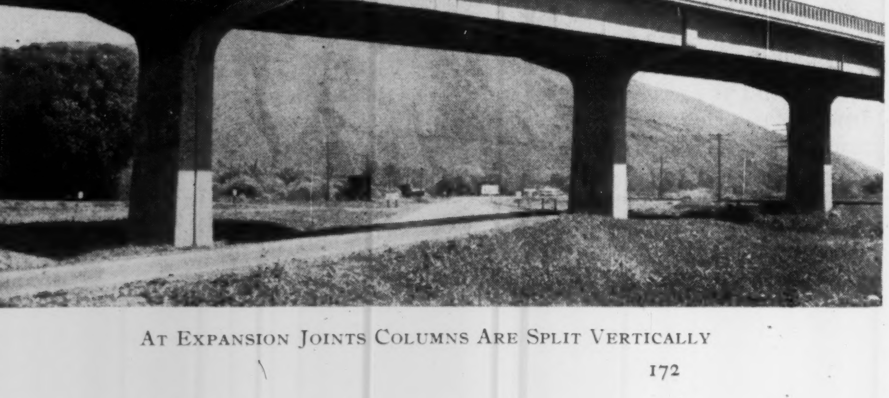
The State of Washington, Department of Highways, within the last five years has constructed two reinforced concrete highway overcrossing structures utilizing this type of construction. In each case a skewed design would otherwise have been necessary. The first of these is a viaduct-type structure at Union Gap, Wash., a few miles south of Yakima, which carries Secondary State Highway No. 3-A over one leg of Primary State Highway No. 3, and the tracks of the Northern Pacific Railway Company and the Oregon-Washington Railroad and Navigation Company.

In making the preliminary studies to determine the type of structure best adapted to the requirements of the site, a structure with skewed bents was considered. It was found that, because of the location of the existing tracks and the requirements for future trackage, no duplication of span lengths could be achieved, and that the angle of skew in each series of spans would be different. The appearance of such a structure would not be good, and both the design and construction costs would be high. Consideration was also given to eliminating the skew by the use of longer spans over the tracks and highway but this resulted in a higher grade line and a longer structure because of the greater depth of the long spans.

The single-column design, which was adopted, eliminated all skewed construction and in addition permitted a duplication of span lengths not possible in any other type of construction. Views of the completed structure are shown in the accompanying photographs. From north to south it consists of a two-span rigid-frame unit with a cantilever extension, two similar rigid-frame units of three spans each, and a two-span rigid-frame unit with a cantilever extension. The clear span is uniform in length on both the three-span units and the south two-span unit, and the two spans of the north unit have the same clear span.

The roadway width is 26 ft 0 in. between curbs, and one sidewalk 3 ft 6 in. wide is provided on the east side. The design loading is H-15, and the details of design are in accordance with the State of Washington Department of Highways Design Specifications of 1935, which parallel very closely the American Association of State Highway Officials' Specifications of the same date. The unit stresses used in the design are 1,200 lb per sq in. in concrete having a design strength of 3,600 lb and 18,000 lb per sq in. in the reinforcing steel.

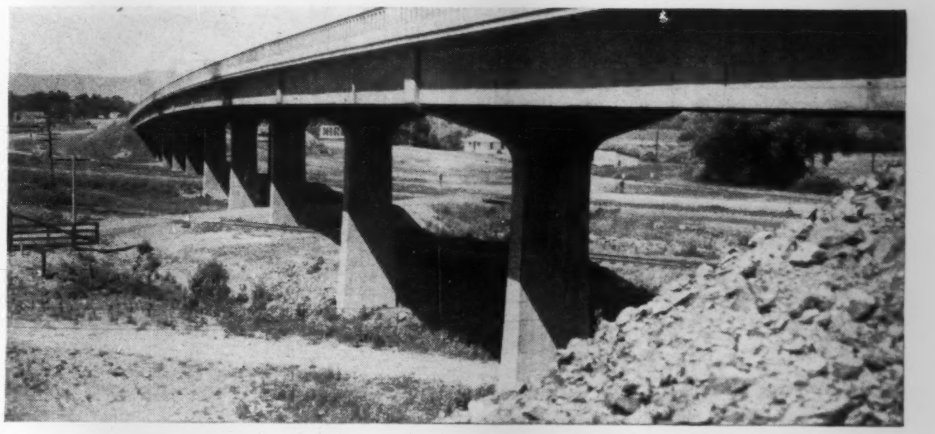
Preliminary test borings indicated a very hard gravel formation a few



At Expansion Joints Columns Are Split Vertically feet below the ground surface. It was therefore possible to secure at a minimum of cost the unyielding foundations so essential to successful rigid-frame construction. Because of the low water-table at the season during which construction was undertaken, the foundations were built in open excavations with but little difficulty from ground water. The footings for two bents adjacent to the railroad tracks are constructed with their long axes parallel to the tracks instead of at right angles to the center line of the structure, as is the case for all other footings. This was done to permit construction without interference with the tracks or the trains moving over them. In these cases the overturning forces on the footings act about axes at a diagonal with the sides of the footings.

All bents in the structure are single columns with a horizontal beam at the top to form a T-shaped section (Fig. 1). The girders are framed into the horizontal element (Fig. 2) to provide as much vertical clearance as possible at the junction of the bent and the outside girders, and to present a pleasing architectural appearance. A curve of 3-ft radius is introduced between the sloping soffit of the horizontal element and the face of the column to produce smooth transition lines between the two elements and at the same time to provide the necessary section for stress requirements. All four vertical faces of the column below the point of tangency of the 3-ft curve have a variable batter increasing downward in the form of a parabola. The solid columns have a cross section of 3 ft 0 in. by 6 ft 6 in. at the point of tangency of the parabolic batter curve and the 3-ft radius of the transition curve.

At the junction between each pair of rigid-frame units, the columns are split vertically at right angles to the center line to allow for changes in length due to temperature. The transverse open joints at these points extend entirely through the structure from the top of the handrail to the top of the common footing supporting the two halves of the split column. This joint is 1 in. wide through the roadway slab and handrails, and 2 in. wide between the halves of the T-bents. The 1-in. opening in the roadway slab, curbs, and sidewalk is covered with a steel expansion-plate assembly to exclude dirt, but elsewhere the joint is open.


Union Gap Overcrossing Separates Highway and Railway Grades

The split columns are identical with the solid columns except that the minimum dimension in a direction parallel to the center line of the structure is 1 ft 8 in. for each half. Thus, the overall thickness of the split columns is 3 ft 6 in. at the narrowest point as compared to 3 ft 0 in. for the solid columns.

Each section of the bridge between expansion joints is a rigid-frame unit, with the relative stiffness of the columns and girders included in the calculations for stress distribution. In this type of design, both elements of the T-bent are subject to torsional stresses due to unsymmetrical loading with respect to the longitudinal center line of the bridge, and this torsional stress was taken into account in the design. Torsional reinforcement in the form of diagonal bars in the faces of the T-bents was used to provide for these stresses.

For architectural reasons, it was felt that the soffit lines of the outside girders should be parallel with the roadway grade, but for maximum economy, girders having a variable depth were required. To resolve this conflict, all girders were made with curved soffits to conform to stress requirements, and a curtain wall was added to the outside girders to produce the desired appearance. This curtain wall, having a thickness of 4 in., was constructed integrally with the girder as a downward projection of the amount necessary to produce a straight soffit line.

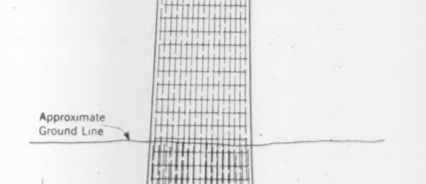


Fig. 1. Typical Column of Viaduct

In order to prevent this thin section from participating in the stresses in the girder, $^{1}/_{4}$-in. vertical open joints were provided at 10-ft intervals. These joints are hardly noticeable in the completed structure and have been completely successful in preventing cracks in the curtain wall. The interior girders and the section of the outside girders, exclusive of the curtain walls, have a depth of 5 ft 8$^{1}/_{2}$ in. at the faces of columns and 3 ft 2$^{1}/_{2}$ in. at the center of the span, including the 6$^{1}/_{2}$-in. depth of the deck slab forming the flange of the T-section. All girders are 20 in. wide and are spaced 7 ft 10 in. center to center.

The design successfully accomplished the purpose intended and resulted in a structure both pleasing in appearance and economical in cost. Because of good foundation conditions, the footings contain slightly less materials than would have been the case with a separate column under each of the four girders. This is because the footing dimensions are controlled entirely by the bearing value of the foundation material and are independent of the width of the bridge. The columns contain about the same volume of concrete as four separate columns of smaller dimensions but required fewer square feet of forms and involved less difficulty in concrete placement. The remainder of the structure, through the elimination of all skewed framing and by virtue of the duplication in span lengths, resulted in appreciable economies of construction.

A second structure of the same type has been constructed near the west city limits of Spokane. At this point a new two-lane highway joins the

A SIMILAR STRUCTURE IS THE SPOKANE WEST OVERCROSSING, WHICH UTILIZES CURVED SOFFITS

four-lane divided highway forming the main entrance to the city. The volume of traffic is such as to require a separation of opposing lanes, and topographic conditions are such as to lend themselves to a grade separation.

The general layout of roads required the south-bound lane of traffic on PSH-11 to cross under the east-bound two-lane traffic stream on PSH-2 at an angle of 55° 28′. A structure designed for this very sharp skew would be undesirable in appearance, expensive to construct, and possibly unsatisfactory in performance. Conventional piers or bents set at right angles would require a span length of no less than 115 ft to provide the desired unobstructed width on the lower roadway.

A single-column design was adopted, which provided the desired clearance with a central span of 90 ft. Two side spans, each 75 ft long with cantilever extensions of 17 ft, make up the additional length of structure required.

The bridge was designed for H-15 loading and provides a 26-ft roadway for two lines of traffic in the same direction. One sidewalk 3 ft 6 in. in width is provided for the few pedestrians using the structure. The bridge site is in a natural coulee in the columnar basalt prevalent in this area, and the footings are founded on this material only a short distance below the natural ground surface. The T-shaped columns of the two central bents are of the same general design as those at the Union Gap Overcrossing. Because of the greater span lengths, they are somewhat heavier, having a cross section of 3 ft 9 in. by 7 ft 6 in. at the point of minimum section just below the horizontal member of the "T."

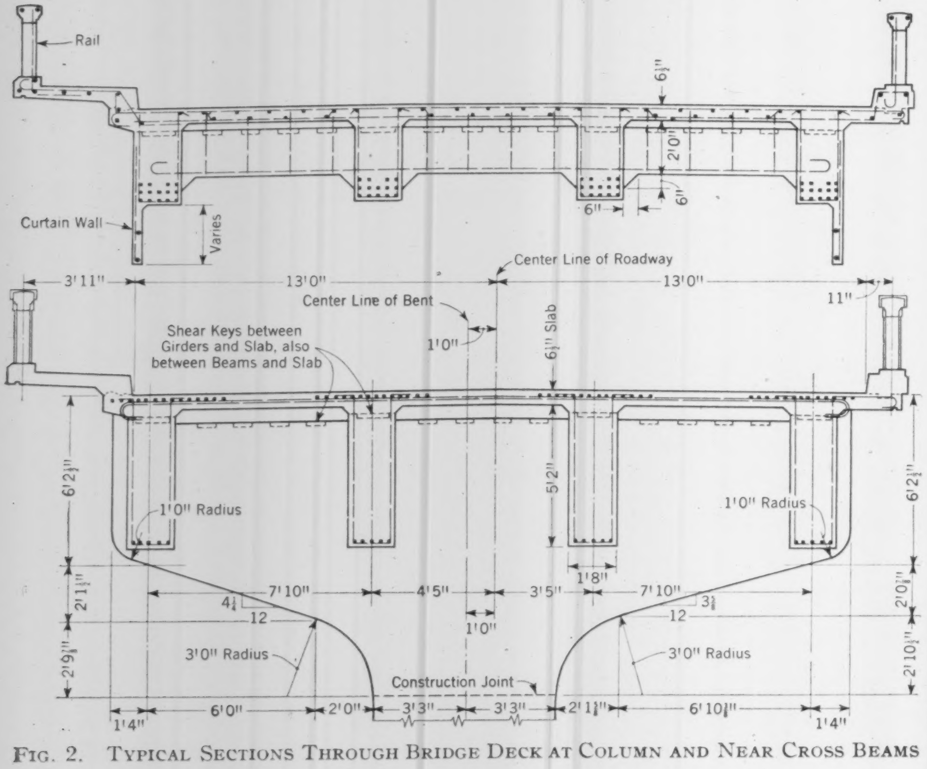


FIG. 2. TYPICAL SECTIONS THROUGH BRIDGE DECK AT COLUMN AND NEAR CROSS BEAMS

The entire structure is a monolithic rigid frame, except that the end spans are simply supported at the end bents. At these points, the change in length due to temperature is provided for by introducing a rocker in the form of a 5-ft section of column, hinged to the superstructure at the top, and to the lower portion of the column at the bottom. Because of the necessity for these hinges, the end bents are of conventional design, having a column under each girder. The hinges are of the Mesnager type, capable of resisting shear but permitting rotation of the magnitude required.

CURVED SOFFIT LINES

In contrast to the straight soffit lines of the outside girders on the Union Gap Overcrossing, all girders in this structure are varied in depth to conform approximately to the requirements for stress. The girders in all spans are 7 ft $^1/_2$ in. deep at the bents and 4 ft $9^1/_2$ in. deep at the center. The curve between these points is parabolic in form.

The 17-ft cantilever extension of the structure beyond the end supports serves to decrease the positive moments in the side spans, which would otherwise exceed those in the central span because of the absence of restraint from the end bents. At the same time it improves the appearance of the structure by keeping the embankment slopes back of the end support, thus preserving the symmetry of the soffit curve in the end spans.

The construction was carried out during the war, and in spite of the difficulty of securing high-grade form lumber, exceptionally good results were obtained. The rapidity with which the work was completed during a time of acute labor shortage supports the belief that the single-column design has construction advantages, as well as those of economy and appearance, over a skewed structure.

Both bridges were designed under the supervision of the writer. James A. Davis was Acting Director of Highways at the time the plans were prepared for the Union Gap Overcrossing, and Burwell Bantz, M. ASCE, was Director of Highways during the design of the Spokane West Overcrossing. Both structures were built by contract, the first by M. P. Munter of Seattle, Wash., and the latter by Henry Hagman of Cashmere, Wash.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

"Common Well" Nomograph

By Ira J. Hooks *and* Hamilton Gray, Assoc. M. ASCE, Professor of Civil Engineering, University of Maine, Orono, Me.

The Dupuit or "common well" formula forms the theoretical basis for many engineering estimates dealing with the lowering of the ground-water table for construction purposes, or with the production of commercial water supplies from pumped wells. The various assumptions underlying Dupuit's development include the following:

1. The original ground-water table is horizontal.
2. An impervious stratum with horizontal surface underlies the aquifer.
3. The aquifer is homogeneous and isotropic with respect to its permeability. In other words, the coefficient of permeability does not vary from point to point, and is the same in all directions.
4. No infiltration occurs within the drawdown or influence zone, but all water enters the aquifer from beyond the limits of the drawdown curve.
5. The flow is independent of the time, that is, equilibrium of the lowered water table has been obtained.
6. The well penetrates the aquifer to the top of the impervious stratum.
7. The hydraulic gradient is equal to the slope of the lowered ground-water table and is constant along vertical lines.
8. The flow is parallel to the surface of the impervious stratum.

The first five assumptions are never fulfilled by nature and the results obtained by using Dupuit's formula must, therefore, be considered as approximate. In order to account properly for deviations from these assumptions, a modification of Dupuit's formula and a detailed study of the pattern of flow are often required. The last two assumptions are theoretically incorrect, but experience and experiment indicate that if the slope of the ground-water table is rather small, the results obtained by Dupuit's formula are satisfactory. The result of Dupuit's analysis is

$$q = \pi k \frac{H^2 - h^2}{ln(R/r)}$$

in which q denotes the rate of water-discharge from the well, k denotes the coefficient of permeability of the aquifer, and the coordinates of any two points on the drawdown curve are given by (R, H) and (r, h), respectively. The values of H and h are measured vertically from the surface of the impervious stratum, and the values of R and r are measured from the center of the well. Any consistent system of units can be used.

A GRAPHICAL SOLUTION

Because this formula involves the difference of two squares and a logarithmic factor, its use is a trifle cumbersome for preliminary computations, and a graphical solution is very convenient. A nomograph is here presented which may be used for this type of problem (Fig. 1). Three varieties of computations are involved, as follows:

1. If the coordinates of two points on the lowered water table are known, together with the coefficient of permeability, it is possible to find the discharge from the well.
2. If the coordinates of two points on the lowered water table are known, together with the discharge, it is possible to find the coefficient of permeability.
3. If both the discharge and the permeability coefficient are known, together with the coordinates of one point on the drawdown curve, it is

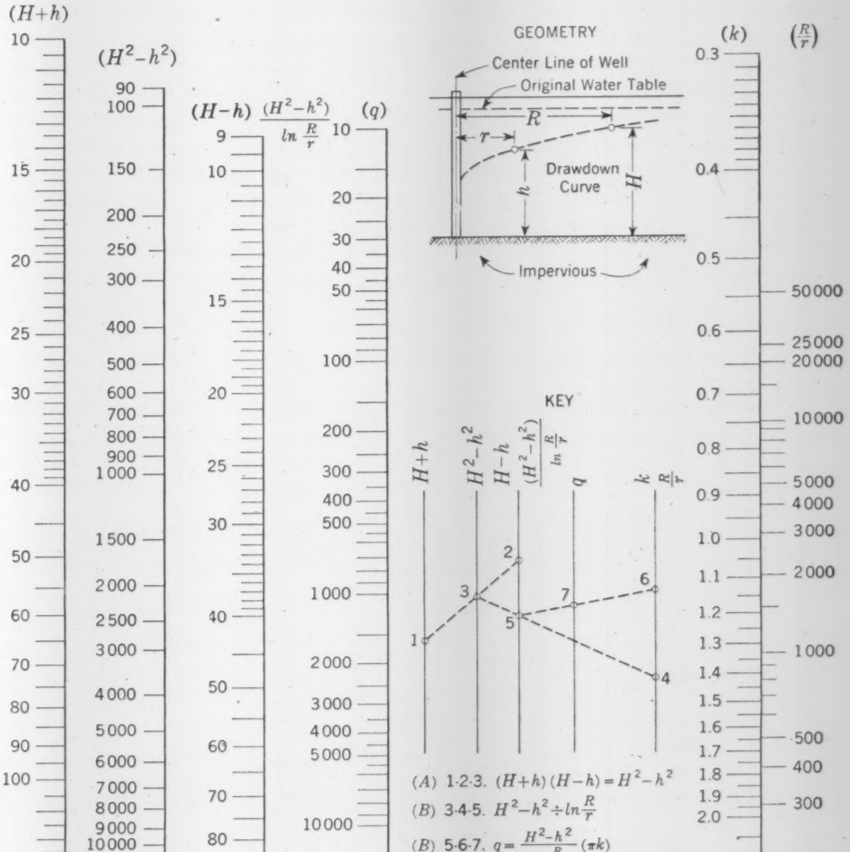

(H+h)
10 15 20 25 30 40 50 60 70 80 90 100 150 200
(H²−h²)
90 100 150 200 250 300 400 500 600 700 800 900 1000 1500 2000 2500 3000 4000 5000 6000 7000 8000 9000 10000 15000 20000
(H−h)
9 10 15 20 25 30 40 50 60 70 80 90 100
(H²−h²)/ln R/r
(q)
10 20 30 40 50 100 200 300 400 500 1000 2000 3000 4000 5000 10000 20000 30000 40000 50000
GEOMETRY
Center Line of Well
Original Water Table
R
r
Drawdown Curve
h
H
Impervious
KEY
H+h
H²−h²
H−h
(H²−h²)/ln R/r
q
k
R/r
1
2
3
4
5
6
7
(A) 1-2-3. (H+h)(H−h) = H²−h²
(B) 3-4-5. H²−h² ÷ ln R/r
(B) 5-6-7. q = (H²−h²)/(ln R/r) (πk)
(k)
0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.5 3.0
(R/r)
50000 25000 20000 10000 5000 4000 3000 2000 1000 500 400 300 200 100

Fig. 1. "Common-Well" Nomograph and Geometry of Water Surface possible to find the depth of the water at a given distance from the well.

SOLUTION OF PROBLEMS

The first problem is solved as shown by the key on the nomograph. That is, Step A consists of laying a straightedge on the chart in such a manner as to connect Point 1 $(H + h)$ and Point 2 $(H - h)$. Point 3 $(H^2 - h^2)$ is thus determined. In Step B, the straightedge connects Points 3 and 4 (R/r), to determine Point 5 $[(H^2 - h^2)/ln (R/r)]$. The final Step C is to connect Points 5 and 6 (k), to secure Point 7 (q). The second problem is solved in exactly the same way except that the final Step C is to connect Point 5 to Point 7 (q) in order to read the value of k at Point 6. The third problem is solved by connecting Points 6 and 7 to obtain Point 5, and then connecting Point 5 with Point 4 in order to obtain the value of $(H^2 - h^2)$ at Point 3. The expression $H^2 - h^2$ can then be readily solved on the slide rule to obtain the unknown value of h.

Since the discharge is proportional to the permeability coefficient, multiplying k by any power of 10 requires that q be multiplied by the same power of 10. This fact is constantly utilized because of the very large range in values of k met with in different types of sandy soils.

A Device for Classroom Demonstration of Moving Loads

By D. D. HAINES, ASSOC. M. ASCE
ASSOCIATE PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF KANSAS, LAWRENCE, KANS.

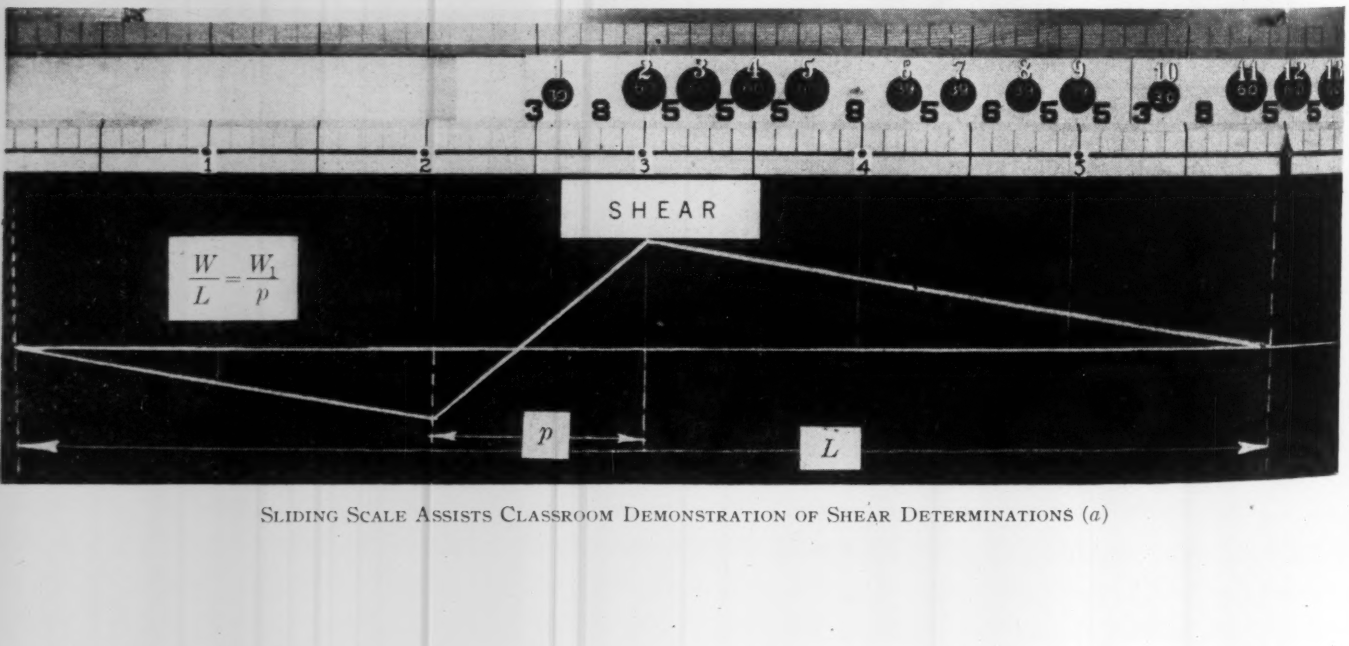
IT is difficult to explain to students the effect of moving concentrated loads on spans with floor beams. In order to do this thoroughly many carefully constructed sketches must be made on the blackboard. These require much time. Frequently the available blackboard space is so limited that much of the work must be erased as the explanation proceeds. The usual result is that by the time the climax of the explanation has been reached, some student inquires about the conditions at some earlier point in the discussion. In order to answer such an inquiry properly, the sketch relating to the question should be used again. If it has been erased it must be reproduced. Obviously, if this occurs a few times during the explanation of a problem, much valuable time is lost in redrawing sketches.

SLIDING SCALE DEVELOPED

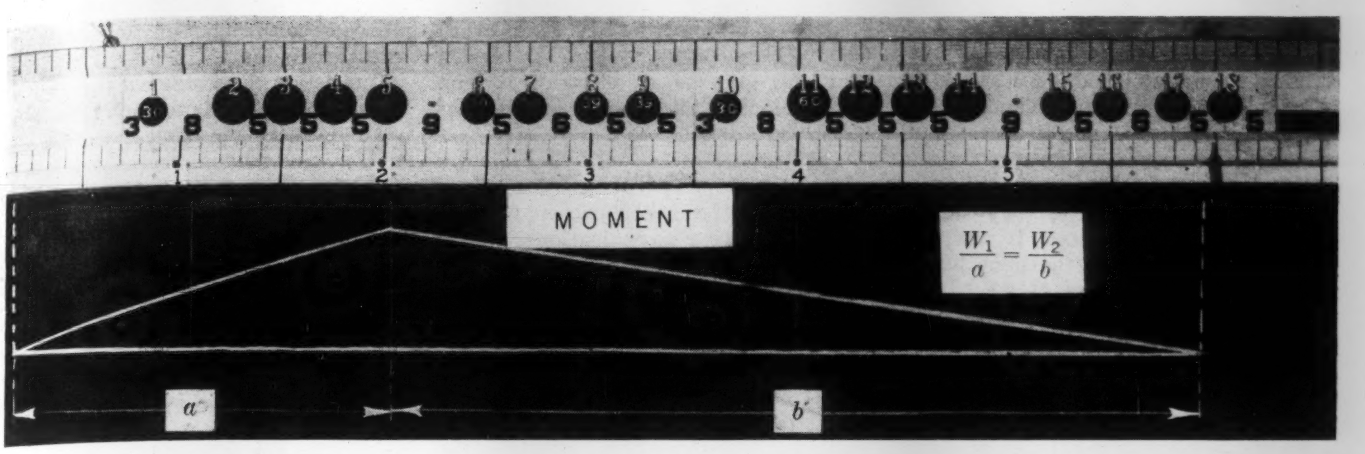
In an effort to save time, and in order to enable the student to visualize properly the relative positions of the concentrated loads, the writer has developed a sliding scale using Cooper's E-60 loading. This scale is 7 in. wide and a little over 7 ft long. It is large enough to be seen clearly from several rows back in any lecture room when hung from the top of the blackboard. The sliding portion of the device illustrates two E-60 engines in tandem, followed by a uniform load of 6 kips per ft. The figures at the top of the slide indicate the conventional numbering for the wheels.

The circles shown represent the wheels and the numbers painted on them give the axle load in kips. The figures below the wheels and between them give the spacing between the wheels in feet. The center of the axles is indicated by the small vertical lines at the base of the slide. The wheels are placed horizontally to a scale of 1 in. = 2 ft. The stationary part of the device is built to the same scale, with vertical marks at the top and bottom at 2-ft intervals. The ends of the span are marked by red arrows, and the panel points are marked by red dots. These are all adjustable by sliding along a groove built into the lower portion of the rule. The maximum span that can be demonstrated is 130 ft. Span and panel lengths can be adjusted to any value within this limit.

An illustration will serve best to demonstrate the use of the rule. Suppose it is desired to find the position of loads that will produce maximum shear in Panel 2–3 of a girder of 6 panels of 20 ft each. The arrows (see accompanying photograph) are first set at the ends of the girder, 120 ft apart. The red dots are then moved to their proper panel points at 20-ft intervals. With the device hanging from the top of the blackboard, the influence line for shear in the panel is drawn on the board beneath it. The criterion for shear is: $W/L = W_1/P$, or the shear passes through a maximum when the average load in the panel is equal to the average load on the span. Suppose Wheel 2 is placed first an infinitesimal distance to the right of Panel Point 3. A quick glance will reveal that Wheels 1 to 11 are on the span, and only wheel 1 is in the panel. Hence $\frac{516}{6} > \frac{30}{1}$, and the criterion is not satisfied. The load is then moved forward in the slide until Wheel 2 is just to the left of Panel



SLIDING SCALE ASSISTS CLASSROOM DEMONSTRATION OF SHEAR DETERMINATIONS (*a*)



SLIDING SCALE ASSISTS CLASSROOM DEMONSTRATION OF MOMENT DETERMINATIONS (*b*)

Point 3 in Panel 2–3. Then $\frac{516}{6} < \frac{90}{1}$ and the criterion is satisfied, so the maximum shear in Panel 2–3 occurs with Wheel 2 at Panel Point 3.

When used to demonstrate the position of loads for maximum moment in a girder with floor beams, the slide is also helpful. As an illustration, suppose it is desired to find the position of Cooper's E-60 loading which will produce maximum moment at Panel Point 2. Again the influence line (accompanying photograph) is drawn first on the board beneath the device. The criterion is: $W_1/a = W_2/b$.

Suppose Wheel 5 is the first to be tried at Panel Point 2. The slide is moved with Wheel 5 in this position. It is readily seen that Wheel 17 is on the span.

With Wheel 5 to the right of Panel Point 2, $\frac{210}{2} < \frac{603}{4}$.

With Wheel 5 to the left of Panel Point 2, $\frac{270}{2} < \frac{543}{4}$.

Since Wheel 5 does not satisfy the criterion, the slide is moved until Wheel 6 is at Panel Point 2. The device shows that 3 ft of the uniform load has moved onto the girder.

With Wheel 6 to the right of Panel Point 2, $\frac{270}{2} < \frac{600}{4}$.

With Wheel 6 to the left of Panel Point 2, $\frac{309}{2} > \frac{561}{4}$.

Wheel 6 at Panel Point 2 therefore satisfies the criterion.

Should any student want to refer ~~(back)~~ to the previous position of the loads, it takes only a second to replace the wheels in their former positions, and the student readily grasps the entire picture. This device saves much time and enables the student to understand better the effect of moving loads on spans with floor beams.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Phenomenon of "Flashes" Studied at Grand Coulee Dam

DEAR SIR: The phenomenon of lightning-like "flashes"—described by G. H. Hickox in his paper, "Performance of TVA Structures Studied," in the October 1945 issue, and in the subsequent discussion—has been observed in the tailrace of the east power house at Grand Coulee Dam, where temporary outlets have been installed to by-pass water from the spillway section while repairs are made to that part of the structure.

Needle valves having 84-in. diameter exits have been installed at the ends of the power penstocks in eight of the turbine bays. The valves are connected by welded steel cones and elbows to the ends of the penstocks just inside the back wall of the power house. The axes of the valves are horizontal and make angles of 41 deg with the axes of the penstocks. An air manifold approximately 1 ft wide with an inside diameter equal to the exit diameter of the valves, equipped with an 18-in. air vent to the atmosphere for preventing the formation of severe sub-atmospheric pressures in the outlet at and beyond the valve exit, is bolted to the downstream end of the valve in each outlet unit.

A transition elbow of welded steel sections, having a circular entrance and an ellipse-like exit, attached to the air manifold and embedded in a large concrete anchor-block placed over the draft tube entrance, forms the flow passage from the valve to the draft tube. The unlined draft tube completes the passage to the tailrace. Operating under approximately 350 ft of head, the needle valve discharges its flow through the air manifold into the transition elbow, which turns the water vertically downward onto the curved surface at the back of the draft tube where it is deflected horizontally downstream through the draft tube passages some 30 to 40 ft below the tailwater surface.

It was in the water immediately downstream from the draft-tube exit of one of these outlet units, when it was operated for test purposes during the 1945 flood season, that the flashes, resembling "sheet" lightning in the distance, were observed by the writer. The occurrence was irregular and varied in extent, but often appeared to form a network of brilliant, irregular, shimmering bands. As a rule, the phenomenon was centered immediately downstream from the draft tube, through which the water was flowing, but it often extended a considerable distance downstream and to the sides of the outlet unit.

When the flashes could not be detected in the darkness, it was concluded that the phenomenon was not electrical, but resulted from pressure waves which changed the refractive and reflective properties of the water as they moved outward into the tailrace. It was not possible to ascertain if the light bands extended below the surface.

Since there were zones of local cavitation within the transition elbow below the valve and in the back wall and floor of the draft tube, it was believed that the pressure waves resulted from the collapse of the cavitation cavities at these points. Though it was difficult to correlate the intensity and frequency of the spectacle with the crepitation and vibration, in general, as these factors increased or decreased with valve opening, the same trend was noted for the "flashes." The phenomenon disappeared at small valve openings where the vibration and noise were at a minimum.

Motion pictures, taken at normal and four times normal speed and various degrees of exposure, were unsuccessful. This is in agreement with the experience of Mr. Hickox.

Attempts are being made to eliminate the cavitation within the units. If these are successful, it will be possible to establish whether or not the phenomenon results from the collapse of cavitation cavities, the discharge of the high-velocity jet into the relatively quiet water in the tailrace, or both. Regardless of the results, it seems that there is sufficient evidence to establish that the phenomenon results from changes in the refractive and reflective properties of the water induced by pressure wave and not from an electrical discharge.

JAMES W. BALL, Assoc. M. ASCE
Engineer, U.S. Bureau of Reclamation
Denver, Colo.

Phenomenon of "Flashes" Seen at New Volcano

TO THE EDITOR: I was interested in Mr. Hickox's reference—in his paper on the performance of TVA structures in the October issue—to lightning-like "flashes" occurring near the outlet of sluices discharging at high velocity, and in the subsequent discussion. During the past summer I had the opportunity of observing a similar phenomenon at the new volcano Paricutin in Mexico. Perhaps of particular interest here is the fact that I found no evidence of associated electrical effects. The volcanologists, I think correctly, refer to this phenomenon as compression waves or compression bands. However, several with whom I have spoken have the impression that the glow is of electrical origin. They describe the color variously as bluish white or yellow.

The purpose of my visit to Paricutin was to determine for the American Committee for the Study of Paricutin whether more exhaustive investigations of the electrical phenomenon of the volcano-cloud would be advisable. Although I left on very short notice, it was possible to take with me a relatively sensitive electrometer for measuring electrical field strength. On a number of occasions it was possible to make electrical observations at a distance of 0.7 mile from the crater during the occurrence of the compression waves; and although electrical field changes of about 0.01 volt/cm should have been detectable, none was in evidence during the occurrence of the compression waves.

My observations and inferences may be briefly outlined. The bands were narrow and horizontal—sometimes single, though frequently as many as five or more successive evenly spaced bands issued from the crater and moved upward at a velocity estimated to be about that of sound. On the numerous occasions when I observed these they were best visible against a background of dull sky, not at all against a dense white volcanic cloud but rather in gaps of that cloud. I saw them only in the morning and evening, which suggests that lighting conditions have something to do with the visibility of these bands.

One day, when a number of bands had been visible in the morning, two men—Dr. W. A. Egler and Mr. Donald R. Hakala, of the biology department of Central Michigan College, Mt. Pleasant, Mich.—climbed the volcano and spent about an hour on the rim of the crater. Although at this time I was observing at a distance of 0.7 mile and could see no bands, they reported very distinct bands visible against the crater wall. These appeared simultaneously with the explosive emission of steam from the smaller of the two vents at the bottom of the crater. Although the steam explosions were much less spectacular and apparently represented a much smaller expenditure of energy than the eruptions of lava and ash from the large vent, the former were much noisier and, so far as my observations could determine, were the only source of the compression waves. I saw no distinctive color. In this respect the bands resembled so-called "heat waves." From these observations and other considerations (see, for example, *Bulletin of the National Research Council*, No. 84, 1932, pp. 543–550; also J. Howard McMillan in *Physics Review*, for November 1945, pp. 198–209), I think that this is purely a refraction phenomenon without any important electrical attributes.

I question the statement that it would be impossible to photograph these bands with ordinary mechanical camera shutters. Some good photographs were taken of such bands at Paricutin with a movie camera at a speed of either 32 or 64 frames per second in July 1945, by Capt. George D. Colchagoff, TSESE, 2C, Wright Field, Dayton, Ohio.

O. H. GISH
Dept. of Terrestrial Magnetism, Carnegie Institution of Washington
Washington, D.C.

The Simplicity of the Metric System a Recommendation

TO THE EDITOR: I have no doubt that the metric system will in the long run prevail because of its simplicity. The English system compels us to have three different systems—the foot with tenths for surveying, the foot and inch with ordinary fractions for most structural and mechanical work, and the inch with decimal fractions down to $^1/_{25,000}$ for mechanical precision work. At bottom there is still a fourth system for surveying—namely, small decimal fractions of the foot, $^1/_{500}$, etc.

In contrast, the metric system expresses all these different part-systems in one single system. There is nothing but decimal fractions of the meter or millimeter, all of which can be expressed in one single figure—for instance, 252.455. Drawing, too, is much simpler, since all the odd fractions for scales—namely, $^1/_{16}$ in. or 3 in. to 1 ft—are replaced with simple decimal fractions, 1:5 or 1:10, down to 1:1,000 or even smaller.

In large sections the metric system is already prevailing. No wireless engineer will calculate his wave lengths in feet or yards, the inductance of his coils or capacitance of his condensers in inches—nothing but in meters or centimeters.

Coupled with the metric system is the centigrade system of temperature measurement, which also offers the advantage of simplicity and is already widely used for electrical machinery, scientific measurements, and other purposes. The completely arbitrary Fahrenheit system with its fixed points at temperatures without any real significance will certainly one day have to give way.

ARTHUR HAMM
Consulting Engineer
Johannesburg, South Africa

SOCIETY AFFAIRS

Official and Semi-Offiical

Survey on the Economic Status of the Engineer

Composed of representatives appointed by six professional engineering societies (including the ASCE), a committee of the Engineers Joint Council is studying the economic status of the engineer. The results are expected to be helpful to the cooperating societies in promoting an improvement in the economic status of engineers, particularly the younger ones who have just attained, or are training for, professional status.

This Committee on the Economic Status of the Engineer has no power to commit the cooperating societies to any course of action, although they have provided it with funds to conduct its studies. The functions of the Committee are solely investigational and advisory, and any action that may be taken by the cooperating societies as a result of its studies is a matter to be decided upon by the boards of direction of the individual societies concerned.

For some time three study or survey committees have been active under the main Committee on the Economic Status of the Engineer, each dealing with a specific phase of the general problem. It should be understood that the interests and activities of the Committee are not necessarily limited to these three specific phases. Should it become evident to the Committee at any time that other specific phases of the problem should be studied, additional survey committees will be established. The three survey committees now functioning actively are the Committee for Survey of Employer Practice Regarding Engineering Graduates, the Committee on Survey of the Engineering Profession, and the Committee on Collective Bargaining by Engineers in Professional Work.

Taking the first of these, the Committee for Survey of Employer Practice Regarding Engineering Graduates, its objective is to learn directly from a substantial but carefully selected representative group of industrial employers, company policies and attitudes regarding the selection, training, placement, advancement, guidance, and professional activities of graduate engineering employees. The specific matter of compensation is not a function of this committee.

The second committee, that on Survey of the Engineering Profession, has the aim of obtaining directly, through a questionnaire to about 100,000 member engineers, specific facts which reflect the economic status of engineers. By means of a pre-coded series of questions, data will be obtained covering educational levels, years engaged in practice, branch of engineering, field of specialization, annual income, and similar information. These data will be analyzed by an expert consultant and a report made ready for publication and distribution to all members of the cooperating societies.

The objective of the third survey committee, that on Collective Bargaining by Engineers in Professional Work, is to study and report on the problem of collective bargaining as it affects, or may affect, engineers in professional work and in training for such work. This committee hopes that all members of the cooperating societies, particularly employee members, will read the recent A.I.E.E. tentative report on collective bargaining reprinted in Civil Engineering for November 1945, pp. 537–542) and related matters and will send in comments. Neither this survey committee, nor the Committee on the Economic Status of the Engineer, endorses or rejects the A.I.E.E. tentative report. Rather it is hoped that the report will serve to inform the members of the societies of the questions involved, and thus help them to submit helpful comments. When this survey committee has obtained sufficient information and comment, it will prepare its own report on collective bargaining. This committee proposes also to work cooperatively with a committee of the A.I.E.E. which, with the help of a competent consultant, now is compiling a manual on this subject. It is hoped that the manuscript of this manual can be made the basis of a manual to be accepted and published jointly by the cooperating societies.

Comments from members of any of the cooperating societies will be not only welcome but sincerely appreciated. Communications should be sent to the chairman or secretary of the Committee on the Economic Status of the Engineer, or to the chairman of the particular survey committee involved.

Personnel of Committee on the Economic Status of the Engineer

I. Melville Stein, Chairman (A.I.E.E.)
Leeds and Northrup Company
4901 Stenton Avenue
Philadelphia 44, Pa.

Col. William N. Carey, Vice-Chairman (ASCE), Secretary and Executive Officer, ASCE
33 West 39th Street
New York 18, N.Y.

Paul T. Onderdonk, Secretary (A.S.M.E.)
Consolidated Edison Co. of New York
4 Irving Place
New York 3, N.Y.

C. S. Proctor (ASCE)
E. J. Stocking (ASCE)
E. G. Bailey (A.S.M.E.)
L. J. Fletcher (A.S.M.E.)
F. B. Foley (A.I.M.E.)
S. Turner (A.I.M.E.)
L. E. Young (A.I.M.E.)
A. C. Streamer (A.I.E.E.)
E. P. Yerkes (A.I.E.E.)
L. W. Bass (A.I.Ch.E.)
J. M. Church (A.I.Ch.E.)
S. L. Tyler (A.I.Ch.E.)

Engineering Library Receives Barstow Bequest of $10,000

For many years William S. Barstow has been a friend of the Engineering Societies Library, housed in the Engineering Societies Building in New York. He has given generously of time and resources as well as of money. From 1931 to 1942 he was a member of the Library Board, and from 1934 to 1942, when ill health forced his resignation, he was on the Executive Committee of the Board.

In the period 1935–1938, Mr. Barstow contributed $7,500 to cover the cost of binding and repairing the Library's rare books. In 1940 he gave $500 for extending the services of the Library, and his recent gift of $10,000 is an addition to the Library's endowment fund.

Some measure of the importance of this library in the engineering world may be gained from the following, from an address by A. R. Mumford, Chairman of the Library Board, given at a dinner in 1939 in honor of William S. Barstow and here quoted from *Mechanical Engineering* for July 1939.

"It is said that a prophet is not without honor except in his own home. So with your library. The average member of the four Founder Societies takes the library for granted. The assistant state librarian of Canberra, Australia, however, told me the other day that he had come half way around this earth to see your library because of its fame as an outstanding example of a specialized institution.

"What makes this greatness?

"Is it the 160,000 [now 175,000] volumes which if placed side by side on a single shelf would be as long as you could walk in one and one-half hours—briskly?

Is it the 1,200 magazines which currently come to the library each year and came during the worst years of the depression?

"Is it the ten thousand dollars worth of books which come free to the library each year in return for the reviews written by its director?

"Is it the fact that more engineering books printed prior to the secession of Texas from Mexico are available in your library than in any other?

"Or is it the alloying of all these with the farsightedness of such men as our guest of honor?

"Latimer Clark's collection is here. This is one of the two greatest collections known in the field of electricity, magnetism, and electrical engineering. This was given to your library by Schuyler Skaats Wheeler. The other, the Ronald collection, is in the library of the Institute of Electrical Engineers in England.

"General Electric and Westinghouse gave us 9,000 volumes on electrical engineering.

"Horace Vaughn Winchell's great collection on mining was given us by the Anaconda Copper Mining Company.

"Conservatively, your library, if not now the greatest collection of engineering books in the world, is the solid foundation for such a collection.

"In these days of low money rates, how pleasing it is to know that your library has grown at the rate of 6 per cent compounded. This growth indicates a virility which must be pleasing to those who realized the need for such an institution.

"An average of 150 persons or firms use the facilities of your library each day. The information so gained helps to develop projects which undoubtedly give employment to many of our profession throughout the world."

Death of Robert Hoffmann, Hon. M. ASCE

ROBERT HOFFMANN, 1865–1946
Honorary Member of the Society

MEMBERS of the Society will be grieved to hear of the death of Honorary Member Robert Hoffmann—in Cleveland, Ohio, on March 2, 1946. Mr. Hoffmann's whole career was devoted to the engineering development of Cleveland, and it has been editorially said that " . . . no one else has fulfilled a career in the public life of Cleveland equal to his."

He was 80 years old, having been born in Cleveland on December 16, 1865. He attended the local schools and then went to Hiram College, graduating in 1885. Later he studied civil engineering at the Case School of Applied Science, from which he received the degrees of B.S. and C.E.

Mr. Hoffmann entered the engineering department of the city of Cleveland in 1893. In 1907, through successive promotions, he became chief engineer—a post he held until 1930, although the title meanwhile had been changed to commissioner and chief engineer of the division of engineering and construction. Since 1930 he had been consulting engineer on public works for the city, although his duties were essentially the same and he continued to keep in close touch with the planning and construction of city engineering projects.

During Mr. Hoffmann's long tenure, Cleveland increased from a city of 300,000 to its present population of over a million. This growth, coupled with the even more rapid growth of the suburbs, has entailed numerous engineering problems—bridging of the many valleys, a complex drainage system, and readjustment of city facilities to accord with the Cleveland Terminal development, to mention a few. For his services in these varied capacities the Cleveland Chamber of Commerce, in 1926, awarded him the rare "Cleveland Medal for Public Service."

Mr. Hoffmann's distinguished career received official Society recognition in 1936, when he was made an Honorary Member. Long active in the Society, he had previously (1932 to 1934) served a term as Director and had been president of the Cleveland Section.

New Format for "Civil Engineering"

APRIL is the month for showers, Spring Meetings of ASCE, and a brand new suit of clothes. (The editors recognize the difficulties involved in achieving the latter but, comfy in our barrels, we can dream, can't we?) What better time to re-dress CIVIL ENGINEERING than April? Thus, and also for several good reasons, this issue will be found upon close examination to be completely redone with a brand new three-column makeup.

Perhaps the change in appearance won't be noticeable—the type and pictures and so on are still there. There are, however, three columns of type (count them) on each and every page from our masthead to our very last word. Formerly, and this may prove confusing, there were only two columns of type.

These new narrower columns, in way of explanation, are easier to read. They are also, to be more frank, a lot simpler to make up into pages, so that we can save some time in getting these interesting, informative, stimulating, helpful articles into the readers' hands and save a little of the Society's money—perhaps. We would prefer to let it go at that and let the readers form their own enthusiastic indorsement of the change.

For the typographist, the main articles are set in 10 on 10 point type with each column $13^1/_2$ picas wide with a one-pica river. Society Affairs are set in 9 on 10 point type, and Items of Interest in 8 on 9. Column width and overall page size are the same throughout the editorial pages.

UNO Planning Committee

AN ASCE committee of three, chosen by the Executive Committee of the Board of Direction, is cooperating with similar committees from three other national societies in offering assistance to the United Nations Organization in the preliminary studies for a national headquarters for that up-to-now "homeless" organization.

Past-President Malcolm Pirnie heads the ASCE committee, assisted by Julius W. Pfau and Past-Director Harold Lewis. The other organizations cooperating by means of similar committees are the American Institute of Architects, the American Society of Landscape Architects, and the American Institute of Planners. Messrs. Pirnie, Dougherty and Lewis will represent, respectively, the sanitary, long-distance transportation, and city planning phases of UNO's problem.

The offer of the four technical societies was made to the UNO in the following communication:

"In view of the complex problems raised in the selection of the best possible location, size and development of the site of the United Nations Headquarters, and in order to clarify the thinking of the American public on the matter, representatives of each of the following technical societies of the United States of America, namely the American Institute of Architects, the American Institute of Planners, the American Society of Landscape Architects, and the American Society of Civil Engineers, have agreed to appoint from their most competent membership a JOINT COMMITTEE ON PLANNING AND DEVELOPMENT to offer its services to the Headquarters Committee of the United Nations which is expected in the United States in the near future.

'The best opinion of the representatives of the four Societies assembled from all parts of the United States at a meeting in New York on March 2, 1946, is that the crystallization of the functions to be carried on in the United Nations Headquarters area is the first problem to be met by the Headquarters Committee in its vital task of selecting the ultimate acreage on which the Headquarters will be located. The national technical societies of America are glad to offer their services to this important preliminary thinking which will play a large part in the selection of the ultimate Headquarters Area and its enthusiastic acceptance by the American public."

American Institute of Architects
American Institute of Planners
American Society of Landscape Architects
American Society of Civil Engineers

Hoover Medal Goes to Electrical Engineer

This year the Hoover Medal goes to an electrical engineer—Maj. Gen. W. H. Harrison, vice-president in charge of operation and engineering for the American Telephone and Telegraph Company. The Medal was presented to General Harrison on January 23 at the annual dinner of the American Institute of Electrical Engineers, of which he is a member. The citation accompanying the award reads, "William Henry Harrison, who in times of peace has been devoted to civic services and effective in his recognition of the essentials of human betterment, and who equally in time of war, inspired by the same ideals, has generously served his country, is awarded by his fellow engineers the Hoover Medal for 1945."

Entering the employ of the American Telephone and Telegraph Company in 1909 as a repairman, General Harrison became an authority in the fields of engineering, design, and layout of all phases of the Bell System plant. In 1940, he went on a leave of absence from the company to head the production division of the War Production Board. He left the latter organization in 1942 to become a brigadier general in the U.S. Army. Later he was promoted to the rank of major general, and was made chief of the Procurement and Distribution Service, Signal Corps.

Established in 1930 in honor of Herbert Hoover, the Medal is administered by the Hoover Medal Board of Award, consisting of representatives of the Four Founder Societies. Previous recipients include Herbert Hoover, Ambrose Swasey, and John F. Stevens, all Honorary Members of the Society.

Honorary Member Francis T. Crowe Dies

World-wide fame as an engineer was the lot of Honorary Member Francis Trenholm Crowe, whose sudden death occurred in Redding, Calif., on February 27, 1946. Mr. Crowe was especially known for having directed the construction of Boulder and Shasta dams, though he also supervised the building of seventeen other great Western dams.

He was born in Trenholmville, Canada, on October 12, 1883. His parents were American, and he was educated here, graduating from the University of Maine in 1905, with the degree of B.S. in C.E. Immediately following his graduation, he became associated with the U.S. Bureau of Reclamation (then the U.S. Reclamation Service), where he was not long in reaching positions of responsibility and leadership. Except for two brief intermissions, he was with the Bureau of Reclamation for twenty years, and before terminating his connection had become general superintendent of construction in the office of the chief engineer, Denver, Colo. During this period with the Bureau, he served as superintendent of construction on Arrowrock Dam; project manager on the Flathead Project; and construction engineer on Tieton Dam.

Francis T. Crowe, 1883–1946
Honorary Member of the Society

After 1925 Mr. Crowe, as field representative for various contracting firms, directed the construction of five important dams designed and built by the Bureau of Reclamation. In 1931 he became general superintendent for the Six Companies, Inc., in charge of the construction of Boulder Dam. Then came two structures not built for the Bureau—the Copper Basin and Gene Wash dams for the Metropolitan Water District of Southern California. His next project—Parker Dam, across the Colorado River—was also built for the Metropolitan Water District of Southern California. The foundations of this structure are more than 200 feet below water level, making it the deepest concrete dam ever built.

In 1939 Mr. Crowe went to Redding, Calif., to be superintendent of the Shasta Dam, a part of the Central Valley Project which was handled by the Bureau of Reclamation. It was his last great project.

Mr. Crowe's distinguished career in engineering was recognized by the Society in 1943, when he was made an Honorary Member. Last year he won the annual award of The Moles for "his skill, ingenuity, and engineering ability in the construction of vast public works, notably in the field of world's highest and deepest dams."

Dr. Craver Retires as Active Library Head

Failing health and the need for greater leisure after passing his seventieth birthday caused Dr. Harrison W. Craver to desire retirement from the active directorship of the Engineering Societies Library. Therefore the Library Board created for him the position of Consulting Librarian, which he assumed on February 1, 1946.

Ever since 1917, when Dr. Craver came to the Library, he has been helping to make it of greater usefulness to the continually expanding membership of the Founder Societies. During the 29 years of his active leadership, the Library has undergone great development and has extended its facilities for reference and research to large numbers of people throughout the United States and Canada.

Dr. Craver was largely instrumental in establishing the "Service Bureau," which provides references and abstracts of any article in any volume in the Library, as well as in setting up the "Photostat Service," which prepares photostatic copies of any article or pages in any volume to be found there. He was responsible for changing the fundamental library procedure to make it possible for any member of the four Founder Societies, no matter where situated in the United States or Canada, to have any book sent to him at a nominal charge. This makes the Library available to all members of the Founder Societies and not exclusively to those in the New York area.

His varied experience and broad acquaintance with many fields of engineering, as well as his pleasant, friendly attitude, have caused those who have sought his aid personally to comment freely that he has never failed to help in the solution of their problems.

The Library Board has expressed its sincere appreciation of Dr. Craver's long, faithful, and competent service and its wish for his continuing satisfaction in the less arduous duties of his new post as Consulting Librarian.

Ralph H. Phelps, Dr. Craver's able assistant, has been made Acting Director of the Library.

Student Chapters Recently Reactivated

WITH the end of the war, a number of Student Chapters began to plan for resumption of an active status, and applications for reactivation are being received at Society Headquarters on an average of once a week. In the "Official Personnel Directory Number" for 1946 all the currently reactivated Chapters were listed. But since that was issued five Chapters have been added to the reactivated list. These are New Mexico State College, Lafayette College, and West Virginia University, all on March 1; the State University of Iowa, on February 4; and the University of Akron, on March 7.

As of this writing, plans are also under way for the reactivation of Clemson Agricultural and Mechanical College of South Carolina.

EJC Acts on Two Bills Before Congress

SUPPORT of one bill before Congress, and opposition to another, were decided upon, together with recommendations to its constituent members and their local sections, by Engineers Joint Council at its quarterly meeting held in the ASCE Board room on March 7.

Action was taken on both matters on recommendations made by the EJC Panel which, in making the first appearance of its kind, successfully opposed the then-proposed so-called Science Legislation at a Senate hearing last fall. Dr. Boris A. Bakhmeteff, Honorary Member, ASCE, is chairman of the Panel.

EJC recommended to its constituent members that they support S-1850, a bill now sponsored by Senators Kilgore, Magnuson, Johnson, Pepper, Fulbright Saltonstall, Thomas, and Ferguson, as a substitute for all the former bills referring to a National Science Foundation, which have been withdrawn. In addition, EJC urged its constituent members —ASCE, AIME, AIEE and AIChE—to forward copies of the Panel's favorable recommendations to their local sections in recommending support of this new measure, with the thought that the local sections, and their individual members in turn, would make their favorable attitudes on the legislation known to members of Congress in general, and, in particular to Senators Harley Kilgore and Warren Magnuson, who sponsored the original, though differing bills.

Engineers to Be Chosen

With the approach of realization of the aims set forth and defended by the EJC Engineers Panel in connection with establishment of the National Science Foundation, the Research Committee of ASCE has recommended that EJC select five engineers, one from each of its constituent societies, and that EJC and the societies urge the appointment of one of the five to the National Science Board of the Foundation. EJC action on this recommendation was to authorize its chairman, Alex D. Bailey, junior past-president, ASME, to appoint a committee of three to consider this suggestion and to present the desired list of names to EJC at its next meeting.

OPPOSE FULBRIGHT BILL

The measure which EJC went on record as opposing is the so-called Fulbright bill, S-1248, which is a revival of an attempt to set up a Government-controlled and financed "office of technical services," in competition to the consulting and industrial research practices of the engineering profession. In addition to voicing its own opposition, EJC recommended that its constituent societies print a résumé of this bill in their publications at the earliest possible date, and instructed the president, vice-president, and secretary to EJC to consider the desirability of having a second panel to take action in connection with this new bill, contingent upon the support of the societies.

In recommending EJC support of the substitute bill S-1850 for creation of a National Science Foundation, the panel pointed out that engineering and technology, which were ignored in the original proposed bills, have been properly recognized, subsequent to appearance of the societies' Panel under sponsorship of EJC, and that the new bill provides for a special "Division of Engineering and Technology."

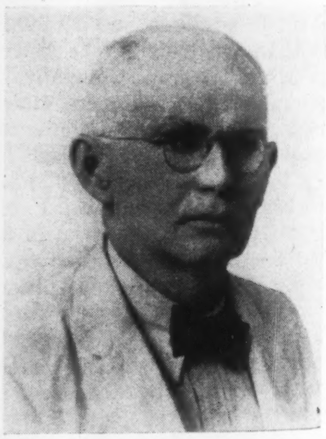
Hailing the new bill as one in which "a reasonable and most satisfactory solution has been reached," the Panel emphasized that it has eliminated the bureaucratic setup contained in its predecessor bills, which was the principal point of controversy, by providing for a strong executive in the form of an Administrator, but at the same time providing for an "authoritative and independent National Science Board, composed of nine members appointed by the President with the advice and consent of the Senate from among persons who are especially qualified to promote the broad objectives of the act."

The Panel reported that the bill "comes as close to achieving ideal legislation as is possible at the present time"; that it is a "document which combines sound scientific thinking with sagacious political realism and to which scientists can unhesitatingly lend their support."

Members of the Engineers Panel, together with other scientists who fought against the original Kilgore bill, EJC was told, consider it vital that all forces be alined back of the united bill, S-1850, to insure its quick and safe passage through Congress, and urge "immediate and active support" for it.

Vice-President A. C. Polk Is Dead

THE death of Armour Cantrell Polk, Vice-President of the Society—in Birmingham, Ala., on March 1, 1946—will come as a shock to members of the Society, which he served long and indefatigably. He was Director from 1940 to 1942, and at the time of his death was serving as Vice-President from Zone II.



A. C. POLK, 1879–1946
Vice-President of the Society

His term would have expired in January 1947. Mr. Polk held various offices in the Alabama Section and was on many Society committees before and while he was on the Board of Direction. He was awarded the Thomas Fitch Rowland Prize in 1916.

Mr. Polk was born in Little Rock, Ark., on September 12, 1879, and brought up in Texas. He received a civil engineering degree from Virginia Military Institute in 1899, and later attended Rensselaer

Polytechnic Institute, graduating in 1903 with the degree of C.E. From the latter year to 1911 he was employed on the construction of the Pennsylvania Railroad tunnels under the East River, New York; on public utility construction in New Orleans, La., and Mobile, Ala.; and on railroad location and construction in Texas.

From 1911 to 1923 Mr. Polk was superintendent, district engineer, and construction manager for Sanderson and Porter on various utility projects, oil pipe lines, and hydroelectric projects throughout the United States. He then became president of the Dixie Construction Company, of Alabama. During this period (1923 to 1930) he had under his direction the construction of six hydroelectric dams, several hundred miles of transmission and distribution lines, steam electric stations, and similar utilities throughout the Southeast.

From 1930 until his death Mr. Polk maintained a private consulting practice in Birmingham. In this capacity he designed and supervised the construction of the Birmingham Industrial Water Supply System, and was resident partner on the design and supervision of the Anniston Ordnance Depot and Camp Sibert for the U.S. Army and a number of smaller war projects in the South.

Active Flood Committee Proposed

Study of floods will be intensified with reactivation of the Society's Joint Committee on Floods, according to the recent report of that Committee's chairman, Gerard H. Matthes. Work of the Committee during the war was suspended because of the exigencies of the times and not because there was any lack of need for continuing the studies.

In his report concerning the past year's records, Mr. Matthes cites the importance of the Committee's studies and recommends particular fields in which activities should be resumed. First considered in the report is the establishment of a group to compile flood data and furnish this information to the profession.

Other subcommittees recommended in the report deal with underscour at bridge piers and abutments, and with the review of statistical flood-frequency methods. Subcommittees in process of formation will cover check dams, debris dams, and debris basins; also the design and operation of flood control structures other than reservoirs.

The Joint Committee on Floods is a cooperative activity of eight of the Technical Divisions of the Society—City Planning, Engineering Economics, Highway, Hydraulics, Irrigation, Power, Sanitary Engineering, and Waterways.

Gail Hathaway Succeeds A. C. Polk as Vice-President

In accordance with the Constitution, which stipulates that a vacancy in the office of Vice-President shall be filled by the senior Director from the same Zone, Gail A. Hathaway will complete the unexpired term of A. C. Polk, Vice-President of the Society, who died on March 1.

Since 1937 Mr. Hathaway has been in the Office of the Chief of Engineers—for part of this period in the capacity of chief of the Reservoir Operation and Hydrology Section. He has been active in sponsoring meteorologic studies of flood-producing storms, and is author and co-author of many important papers on meteorologic subjects. During the war he served as head engineer in the Office of the Chief of Engineers, and was recently awarded a Presidential Citation and the Bronze Star Medal for his work as technical representative of the Chief of Engineers in the European Theater of Operations. At present he is special assistant to the Chief of Engineers.

Elected a member of the Society in 1934, Mr. Hathaway served on the Hydrology Committee of the Hydraulics Division from 1941 to 1943, and on the Society's Committee on Employment Conditions in 1943. He began his term as Society Director from District 5 in January 1944. For several years, also, he has been active in the District of Columbia Section, of which he was president in 1942.

A successor to Mr. Hathaway as Director from District 5 will be chosen by the Board of Direction soon.

Appointments of Society Representatives

Day, Okes, Assoc. M. ASCE, has been appointed to represent the Society on the Highway Research Board of the National Research Council, succeeding William N. Carey, Secretary and Executive Officer ASCE, who has resigned. John W. Wheeler, M. ASCE, has been appointed to serve as alternate to Mr. Okes.

Kirby Smith, M. ASCE, has been appointed a member of the Executive Committee of the Construction Division for the five-year term ending in January 1951. He will serve as chairman of the Division.

J. C. Stevens, Past-President ASCE, has been appointed to represent the Society on the Executive Committee of the John Fritz Medal Board of Award, succeeding the late Frederick H. Fowler, Past-President ASCE, whose term expired in October 1945.

News of Local Sections

Scheduled Meetings

Cincinnati Section—Regular meeting in the Engineering Societies Building on April 7, at 8 p.m.

Cleveland Section—Dinner meeting at the Cleveland Engineering Societies Club on April 19, at 6:30 p.m.

Colorado Section—Dinner meeting at the Oxford Hotel on April 8, at 6:30.

Connecticut Section—Dinner meeting at the Hartford City Club on April 3, at 6:30 p.m.

District of Columbia Section—Evening meeting at the Cosmos Club on April 23, at 8 p.m.

Florida Section—Dinner meeting at the Seminole Hotel on April 4, at 7 p.m.

Lehigh Valley Section—Regular meeting at Lehigh University on April 8, at 8 p.m.

Los Angeles Section—Meeting at the University Club on April 10.

Maryland Section—Dinner meeting at the Engineers' Club on April 10.

Metropolitan Section—Technical meeting in the Engineering Societies Building on April 17, at 8 p.m. Meetings of the Junior Branch in the Engineering Societies Building on April 10 and 24, at 7:30 p.m.

Northwestern Section—Dinner meeting at the Minnesota Union on April 1, at 6:30 p.m.

Oklahoma Section—Luncheon meeting in the Y.W.C.A Building on April 13, at 3:30 p.m.

Sacramento Section—Regular Tuesday luncheon meetings.

San Diego Section—Dinner meeting at the U.S. Grant Hotel on April 25, at 6:30 p.m.

Tennessee Valley Section—Dinner meeting of the Knoxville Sub-Section at the S & W Restaurant on April 10, at 6.

Texas Section—Luncheon meeting of the Dallas Branch at the Adolphus Hotel on May 6, at 12:15 p.m.; technical meeting of the Houston Branch at the Houston Engineers Club on April 9, at 8 p.m.

Recent Activities

Central Ohio Section

The February meeting of the Central Ohio Section took the form of a joint dinner meeting with the Columbus Technical Council. The technical program for the occasion consisted of a talk by William B. Stout, airplane and automotive designer of Detroit. Developing the topic, "Automobiles of the Future," Mr. Stout discussed the part science and engineering have played in the world's industrial advance. The development of precision tools and instruments, he said, has been of incalculable assistance in that advance.

COLORADO SECTION

Numerous business matters were discussed at the February 11 meeting of the Colorado Section, and the Section's annual student award was presented to W. L. Weaver, of the University of Colorado. An entertaining talk on the war and peace activities of the Federal Bureau of Investigation concluded the program. This was given by R. P. Kramer, special agent for the Bureau.

DAYTON SECTION

The history, operation, and maintenance of the Dayton Municipal Airport were discussed at the February 18 meeting of the Section, the principal speaker being George McSherry, manager of the airport. Of interest is the fact that, at the time the airport was founded in 1935, there were short black-top runways serving only two flights daily and requiring the services of one employee. At the present time, the airport represents a total investment of over $9,000,000, serves 74 daily passenger flights, and requires the services of 175 employees.

DISTRICT OF COLUMBIA SECTION

On February 19, members of the District of Columbia Section heard Perry A. Fellows speak on Ethiopia. Mr. Fellows, who is assistant chief engineer of the engineering branch, Office of International Trade, Department of Commerce, headed a technical mission of fourteen engineering and technical specialists to investigate the possibilities of the country. The mission found a country that is capable of developing a much higher standard of living than it has ever had, provided it can be given proper assistance. Experts in the fields of engineering and agriculture are badly needed, Mr. Fellows pointed out.

DULUTH SECTION

A talk by Ralph Palmer, assistant engineer for the city of Duluth, comprised the technical program at the January 21 luncheon meeting. Mr. Palmer described the proposed new central highway entrance to Duluth, which is being planned by the Minnesota Highway Department in cooperation with the Duluth Engineer Department. The February meeting was given over to business discussion.

FLORIDA SECTION

Members of the Florida Section—gathered for a dinner meeting in Jacksonville on February 1—heard John L. Wilkes speak on the activities of American railroads in the second World War. Mr. Wilkes, who is president and general manager of the Jacksonville Terminal Company, illustrated his talk with colored motion pictures, showing the solution of the enormous problems in transportation that confronted the nation during the wartime period.

INTERMOUNTAIN SECTION

The Intermountain Section held two meetings in February. On the 12th, there was a special dinner in honor of the visiting engineer delegates to the Colorado Water Users' Conference currently being held in Salt Lake City. President Harding called upon an engineer from each state to represent his state with a few remarks; and David P. Miller spoke for the engineers of Wyoming, Carl Anderson for Arizona, and Julian Hinds for California. A more detailed talk on engineering participation in the Colorado River development was then presented by A. M. Smith, state engineer of Nevada and president of the Colorado Water Users' Association. The speaker at the regular dinner meeting, held on the 15th, was E. F. Eldridge, chief of the Sanitary Engineering Section, Ninth Service Command Engineers, who spoke on the utilization and disposal of trade wastes.

IOWA SECTION

The Iowa Section reports an interesting technical meeting—held at Des Moines on the 20th. The feature of the occasion was an illustrated talk on the Red River Project, given by Lt. Col. J. H. Peil, district engineer for the U.S. Engineer Office at Rock Island, Ill. This project is of great interest to the engineers of Iowa, and a lively discussion followed Colonel Peil's talk. During the evening the Section made its annual awards of Junior membership in the Society. The recipients are Marion R. Carstens, of the University of Iowa; and Ensign Robert W. Murray, of Iowa State College. A report by Prof. Frank Kerekes, on the "exploratory conference" held during the Annual Meeting in New York, concluded the program.

KANSAS CITY SECTION

Part of the February dinner meeting of the Kansas City Section was devoted to discussion of Section activities in the coming year. It was emphasized that the Section's major effort must be devoted to assisting veterans, and especially engineer veterans, in their readjustment to civilian life. The guest of honor and principal speaker was Ernest E. Howard, Vice-President of the Society, who discussed current Society activities, as viewed from the background of the recent Annual Meeting.

LOS ANGELES SECTION

The technical program for the February meeting of the Los Angeles Section consisted of the presentation of a paper, entitled "Shasta Dam—Keystone of the Central Valley Project." This was given by William A. Johnson, president of the American Pipe Construction Company. Mr. Johnson's paper, which was supplemented by motion pictures showing high lights of the construction of the dam, proved most interesting.

"Collective Bargaining" was the topic of discussion at the February meeting of the Junior Forum, the principal speaker being Sterling S. Green. Mr. Green is a member of the Society's Committee on Employment Conditions and vice-chairman of the Committee on Salaries.

LOUISIANA SECTION

Numerous business matters were discussed at the annual meeting of the Section, which was held in New Orleans on January 26. One of the features of the occasion was the presentation of a certificate of life membership in the Society to William Beauvais Smith. The annual election of officers, also held at this time, resulted in the selection of C. G. Cappel, as president; Leo M. Odom, first vice-president; Ernest L. Mire, second vice-president; and J. M. LeDoux, secretary-treasurer. The technical feature of the evening was a round-table discussion of Section affairs, with Charles M. Kerr acting as moderator. Participants in the symposium were Mr. LeDoux, who discussed the poor attendance at meetings; George A. Heft, whose subject was aiding the civil engineer in readjustment; Sargent F. Jones, who discussed the rôle of the Section in interesting the younger men; and Walter Scales, who posed the question, "Does the Average Engineer Fulfill His Obligations to His Community?" Each topic stimulated lively discussion from the floor.

MARYLAND SECTION

A talk by Capt. Robert V. Schultz, of the U.S. Naval Reserve, comprised the technical program at the February dinner meeting of the Maryland Section. Captain Schultz spoke on the training of troops in matters of basic sanitation, with particular reference to the situation on the islands of the Pacific. Since most of these islands are coral atolls, it was very difficult to dig for sewage and garbage disposal.

METROPOLITAN SECTION

The design of a fresh fruit and vegetable produce market in Manhattan was described in two coordinated papers, presented before the February 20 meeting of the Metropolitan Section. The authors were M. J. Madigan, of the New

York firm of Madigan-Hyland, and Clinton F. Lloyd, chief architect for Madigan-Hyland.

The Junior Branch of the Section reports two interesting meetings. On January 30, Francis R. MacLeay, chief engineer of the Corbetta Construction Company, discussed recent developments in concrete construction, illustrating his talk with films showing the construction of pre-stressed concrete tanks. The speaker at the February 13 meeting was Albert E. Cummings, research engineer for the Raymond Concrete Pile Company. Mr. Cummings gave an illustrated talk on the difficult problem of providing firm foundations for structures in Mexico City, where settlement has been as much as 5 to 6 ft.

Michigan Section

Various committee reports were read at the January 25 meeting of the Michigan Section. Then the timely topic of atomic energy was discussed by Stuart McLain, chairman of the chemical engineering department of Wayne University. Professor McLain's talk was supplemented by a mimeographed outline and illustrated by lantern slides.

Mohawk-Hudson Section

At the annual meeting of the Mohawk-Hudson Section—held in Schenectady, N.Y., on December 20—new officers were elected for 1946. These are Morris M. Cohn, president; Leo Westfall, vice-president; Conrad H. Lang, secretary; and H. V. Gulick, treasurer. Allen Wagner, Assistant to the Secretary on Public Relations, addressed the Section on the value of intelligently planned and placed publicity, stressing the point that engineers should participate more actively in civic life. Mr. Wagner was substituting for Colonel Carey, who was unable to attend because of the press of Society matters.

Montana Section

The Montana Section joined the growing list of Society Sections on January 18, when a dinner meeting of formal organization was held at the Montana Club in Helena. First on the agenda was the election of officers, which resulted in the selection of Charles S. Heidel, as president; David M. MacAlpine, as first vice-president; George F. Sahinen, as second vice-president; and R. H. Willcomb, as secretary-treasurer. The attendance of 34 represented Billings, Bozeman, Butte, Missoula, Great Falls, and Helena. Mr. Heidel outlined briefly some of the problems confronting the engineers of Montana and the opportunities for service which current conditions afford the Section. Mr. Willcomb then reviewed the steps in the formation of the Section, and a lengthy discussion of plans and activities followed. On February 8, Ben S. Hill, Montana director of the Federal Housing Authority, addressed a meeting on the Authority—its record and its place in meeting the housing needs of the nation during the postwar period.

New Mexico Section

Collective bargaining was among the topics discussed at the January meeting of the Section, which took place at the University of New Mexico in Albuquerque on January 23. The technical program consisted of a talk on water, which was given by Dr. C. S. Howard, of the Water Resources Branch of the U.S. Geological Survey. Dr. Howard's talk was very interesting and answered many of the questions the average engineer might ask concerning the quality of water. As an exhibit, Dr. Howard had an actual cross section of 4-in. water pipe, which had been reduced in capacity to that of a 1-in. pipe by a certain water supply. At the February meeting of the Section—held in Santa Fe on the 20th—Dr. Victor L. Weiskopf gave a talk on "The Effects of the Atomic Bomb."

North Carolina Section

The annual meeting of the North Carolina Section took place in Greensboro on January 12. During the morning session, numerous committee reports were presented, and the annual election of officers was held. The latter resulted in the selection of Mason Garber as president, and Robert E. Stiemke as vice-president. George H. Maurice will continue as secretary-treasurer. The group then heard Lt. Comdr. E. G. Singletary, who recently returned from overseas duty with the Seabees, describe Navy construction projects in Dutch Harbor and the South Pacific. A moving picture, showing the track depression of the Southern Railroad at High Point, N.C., was then presented by Frank Miller, Greensboro consultant. The film showed how it was possible to remove all grade crossings in the city while, at the same time, maintaining a full schedule of train operation. At one o'clock the meeting adjourned for luncheon, after which Dr. Howard E. Rondthaler gave an inspiring address on "What to Do with Germany." Dr. Rondthaler is president of Salem College.

Northwestern Section

A regular meeting of the Northwestern Section was held at the University of Minnesota on March 4. Following a general business discussion, the group heard Harry D. Lovering speak on "An Engineer Reserve Officer's Experiences in World War II." Mr. Lovering was recently released from the Corps of Engineers, U.S. Army, in which he served as a lieutenant colonel. He is now president of the Lovering Construction Company, of St. Paul.

Panama Section

On January 7, Thomas Guardia addressed a meeting of the Section on the Inter-American Highway, commenting particularly on the portion between Mexico and Panama. Mr. Guardia, who is chief engineer of the Panama section of the highway, illustrated his comments with a colored motion picture. Of particular interest was his discussion of the difficulties to be overcome in locating a route for the Highway. On the afternoon of February 9, members of the Section and of the Panama Engineers' Society enjoyed an inspection trip through the plant of the Clay Products Company in Panama City.

Philadelphia Section

A symposium on "Concrete Ships in World War II" was presented at the January meeting of the Section. The principal speaker appearing on this program was Maj. William H. Gravell, consulting engineer at the Hooker's Point Ship Yard at Tampa, Fla., where twenty-four self-propelled reinforced concrete barges were constructed for the armed forces. Following his address, which summarized the general aspects of the concrete ship program, C. C. Ragsdale, of the U.S. Maritime Commission, discussed the details of full-scale mold layout, forming, placing of reinforcing bars, and pouring of concrete. J. C. McCloskey, Jr., an official of the contracting firm at the Tampa yard, concluded the program by showing moving pictures on vacuum concrete processing on ships built at Tampa, and the uses of vacuum processing on dams and other concrete structures.

Pittsburgh Section

Much of the annual meeting of the Section, held on February 5, was given over to a social session. The program included the presentation of certificates of life membership to seven—two of the new life members were unable to be present. Charles F. Goodrich, who recently completed a term as Director of the Society, spoke briefly, as did F. S. Merrill, the Section's delegate to the Annual Meeting in New York.

Puerto Rico Section

On February 7, the Puerto Rico Section held its first meeting of the year, with Past-President Malcolm Pirnie in attendance. The principal speaker was William H. Ludlow, who spoke on zoning—a topic of special interest, because the government is sponsoring a zoning law for the San Juan metropolitan area in the present legislature. On February 21, Col. W. N. Carey, Secretary and Executive Officer, addressed a meeting of the Section in San Juan while in Puerto Rico on government business.

ROCHESTER SECTION

Various business matters were discussed at the February 13 dinner meeting of the Rochester Section. Later in the evening there was an interesting talk by Col. Stephen B. Story, who was the first city manager of Rochester (1928–1932). Colonel Story described his experiences as a member of the American Military Government in Sicily and Italy.

SACRAMENTO SECTION

Charles H. Purcell was presented with his certificate of honorary membership in the Society at the February 19 meeting of the Sacramento Section. He was unable to attend the Annual Meeting in New York when the official presentations were made. At the same meeting, the Section welcomed Walter E. Jessup in his first visit as West Coast representative of the Society. The program on February 19 consisted of a talk by Howard C. Wood, acting bridge engineer for the San Francisco-Oakland Bay Bridge, who informed the group on the Bay Bridge traffic problems. On the 26th, the Section met with the Pacific Coast section of the American Society of Agricultural Engineers, which was holding its 24th annual convention in Sacramento.

ST. LOUIS SECTION

The St. Louis Section reports that it had one of its largest meetings in January, the unusual turn-out being in honor of a veteran member of the Section—W. W. Horner, who was inaugurated President of the Society on January 16. Mr. Horner spoke of the aims and future plans of the Society. Then H. F. Thomson, Director of the Society, discussed the new committee on research, which the Society has formed. In the discussion that followed great interest was expressed in the resumption of the Society's sponsorship of research.

SAN FRANCISCO SECTION

The topic, "Vibration of Suspension Bridges," was presented at the February 19 meeting of the San Francisco Section, the principal speaker being George S. Vincent. Mr. Vincent, who is highway bridge engineer for the Public Roads Administration, was assisted in his presentation by L. H. Nishkian and Glenn B. Woodruff, both of whom discussed his subject.

SEATTLE SECTION

At the January 5 meeting of the Seattle Section a certificate of life membership was presented to William D. Shannon. The other new life members—Nathaniel A. Carle, Oliver P. M. Goss, Lloyd M. Grant, Robert Howes, and William C. Morse—were unable to be present. A program of entertainment and dancing had been arranged for the rest of the evening. New officers for the Section were elected at the meeting held on January 28. These are as follows: M. S. Campbell, president; E. B. Crane, vice-president; and E. C. Jensen, secretary-treasurer.

TENNESSEE VALLEY SECTION

At the January 9 meeting of the Knoxville Sub-Section, Lt. Col. James E. Goddard spoke on the subject, "Engineer Intelligence." Colonel Goddard, who recently returned to the TVA after nearly five years in the Corps of Engineers, U.S. Army, described most interestingly the organization of the Army in the field, the part maps play, the use of terrain models to instruct the men before attacking, and other phases of his experience in the European Theater. The list of guests included two Society officers—Prof. Franklin Thomas, Vice-President from Zone IV, and Dean N. W. Dougherty, Director from the local District.

TEXAS SECTION

Owner-contractor agreements were discussed at the December 10 luncheon meeting of the Fort Worth Branch. A talk by E. C. Woodward, district engineer for the Texas State Highway Department, comprised the technical program. Mr. Woodward spoke on the importance of acting now to improve the highway system within Fort Worth. He illustrated his talk with plans of the east-west and north-south expressways in typical sections of the city. On February 11, there was a meeting, at which James A. Cotton discussed the eight projects now authorized for the Trinity River improvement program. Mr. Cotton is head of the Fort Worth office of the U. S. Engineer Office.

TRI-CITY SECTION

The January meeting of the Tri-City Section was held at Rock Island, Ill., on the 10th. Following dinner, the subject of "Trends in Stream Sanitation" was discussed by Ben L. Williamson, of the division of sanitary engineering of the Iowa State Department of Public Health. In his talk Mr. Williamson commented on the status of proposed federal and state legislation on stream-pollution abatement in states bordering on the Upper Mississippi River and the present status of stream sanitation in Iowa. An additional feature of the evening was the presentation of a certificate of life membership in the Society to H. P. Warren, a charter member of the Tri-City Section. The February meeting—held in Davenport, Iowa, on the 27th—took the form of a joint session with the Tri-City section of the American Society of Mechanical Engineers. A talk on city planning comprised the technical program, the speaker being Russell H. Riley, a member of the St. Louis firm of Harland Bartholomew and Associates.

WISCONSIN SECTION

On January 17 there was a joint meeting of the Section and the Milwaukee chapter of the Associated General Contractors of America. The speaker of the evening was Harold W. Richardson, whose interesting talk was built around his travels as technical war correspondent for *Engineering News-Record*. Mr. Richardson was with the U.S. Army Atomic Bomb Mission on its trip to inspect the ruins of Nagasaki, Japan, and he illustrated his comments with slides made from his own pictures. He was followed on the program by Mr. Illing, of the Electric Company, who gave an exhibition of the unique lighting facilities of the new auditorium in which the meeting was held.

Student Chapter Notes

CARNEGIE INSTITUTE OF TECHNOLOGY

The recently reactivated Student Chapter at Carnegie Institute of Technology reports an interesting fall semester. A high point in Chapter activities was a field trip to Cleveland, Ohio, on October 27. A feature of the occasion was a trip up the Cuyahoga River in the harbormaster's launch, which enabled inspection of bridges, harbor installations, and steel mills. Later in the day the group visited the Westerly Sewage Disposal Plant. Colored motion pictures and slides, made during the course of the trip, were shown for the benefit of those unable to attend at a smoker on December 20. The Chapter has under way an interesting project of assembling a series of colored slides into a sound-slide film on bridges.

UNIVERSITY OF WYOMING

The University of Wyoming Student Chapter reports that it recently entertained as guest speaker an interesting young graduate student—LeRoy Englehart, an alumnus of Michigan State College, who is working toward a master's degree at the University of Wyoming. Mr. Englehart has been making tests for durability, scale, percentage of voids, and resistance to freezing and thawing of air-entrained concrete, and he gave the student group an interesting talk on air entrainment in concrete mixtures. The Chapter has just been reorganized after a period of wartime inactivity.

ITEMS OF INTEREST

About Engineers and Engineering

Reminiscences of Lord Kelvin

By the late John Younger

William Thompson, better known as Lord Kelvin, was renowned in engineering and scientific circles throughout the world. No less than his renown in Europe was his fame in America, conclusive proof of which was the fact that he was the first, after John Fritz himself, to be awarded the John Fritz Medal, one of the greatest honors in American engineering. The revealing reminiscences that follow are by one of his former students. John Younger, for many years Professor of Industrial Engineering at the Ohio State University, and recently (November 1945) deceased. They appeared initially in the December 1945 issue of the University's Engineering Experiment Station News. *American engineers may be amazed by the extraordinary liberties which the Scottish students took with their great scientific teachers while at the same time holding them in high respect.*

Some years ago I was a student in the University of Glasgow. Arrayed in flaming red gowns or togas we descended on our classrooms for our instruction. As students we were expected to reap the benefit of our studies by our own efforts. The professors were not concerned with instilling knowledge into our heads but only went so far as to hand it out. We had to do the assimilating. As one epigrammist put it, "Our professors could give us the reason, but God alone could give us the intelligence to understand it." This was particularly the case with Lord Kelvin, who was a man of brilliant ideas but a notoriously poor teacher.

A Famous Experiment

I had the good fortune, however, to spend one year with him—his last year as Professor of Natural Philosophy. Well do I remember his famous experiment with the gun and the ballistic pendulum. This pendulum consists of a heavy block of wood suspended by a steel rod from a knife edge. If a bullet is shot into the wooden block it causes it to swing, and the amount of its travel would by mathematical reasoning show the velocity of the bullet. On the appointed day for the experiment Lord Kelvin strode in with an old-fashioned gun—I think it was really a musket, over his shoulder. Amid the applause of his class he arranged the gun in a V-block. He then proceeded to fill the blackboard with mathematical relationships and formulas, leaving only a blank space for the length of travel of the pendulum. We as a class were supposed to take down this information, but far too many of us were so eager to see the gun fired that we could not concentrate on the matter. Finally the time came when all that was left to do was to fill in the blank space in the formula. In one stride from the blackboard to the gun, Lord Kelvin seized on the trigger and pulled it. There was a deafening roar followed by clouds of smoke. Lord Kelvin pounced on the ribbon attached to the pendulum, read its length, and amidst the smoke placed the reading on the board. An instant's calculation gave the velocity of the bullet and, while we were still joshing, Kelvin erased the whole board.

Meanwhile we as students were busy. As the gun went off and the smoke rolled out we started singing "Rule Britannia." We ducked our heads under our desks to escape the smoke and then as the atmosphere cleared we solemnly arose, gave a cheer, and marched out of the room still singing.

Another incident was very characteristic of the man. Wonderfully precise and accurate as he was in his work, he had absolutely no sympathy with false precision.

He took the class out to the village of Milngavie (pronounced Mullguy) some eight miles from Glasgow, then a city of one million inhabitants. He led us to a signpost which said, "To Glasgow, 8 miles 247 yards" or some such thing. Lord Kelvin then remarked, "The consummate idiocy of the man who wrote that signpost cannot be condemned too much. Where does his distance end, and why the seeming accuracy which is misleading?"

It will be remembered in this connection that Lord Kelvin, through his nephew Horatio Bottomley, was responsible for the introduction of four-figure logarithms in place of the previously used seven-figure ones—truly a great boon to students, and actually more accurate.

Our classrooms in those days were illuminated by old-fashioned gas jets. On dark mornings the janitor would come in and light each jet individually. As each pop of the jet was heard the class would echo it by a resounding stamp of the feet. Kelvin would smile benevolently at us to our great enjoyment.

A Quick Wit

It was related to us that one day Kelvin had to be absent so he put a notice on the blackboard to the effect that, "On Tuesday next Lord Kelvin will meet his classes at 9:00 a.m." One of the wags in the class erased the "c" so that the notice read "will meet his lasses." Kelvin entered, and seeing the smiles of the class directed at the board, turned and read the change. Without hesitation he erased the "l" leaving it "will meet his asses." Needless to say the students enjoyed the joke on themselves.

An incident on a similar subject occurred when Lord Kelvin, then plain William Thompson, went to London to receive his knighthood. His assistant at that time was Professor Day, an excellent teacher who assumed the duties in William Thompson's absence. A student put up a notice on the door of the classroom, "Work while it is yet Day for the (K)night cometh when no man can work."

One of Kelvin's famous experiments was to demonstrate the shape of a raindrop, which is not spherical as most people believe but rather pear-shaped. He had a thin rubber membrane stretched over a hoop and into this his laboratory assistant, Mr. Black, flowed water until the membrane took the characteristic shape. The membrane was rather obstinate one day and Kelvin grew impatient. "A little more water, Black," he called out, "a little more water." Black had his eyes under the membrane studying its stretch when all of a sudden it broke, deluging his head with the water.

The last time I saw Kelvin I was on a visit back to Glasgow in 1903 or 1904, a year or so before his death. He had been to a concert the evening before and had heard a strange note on the cello. He wanted to find the sound wave of this note and there he was in the physics or natural philosophy laboratory, seated in front of the wind organ trying to reproduce the note and get its characteristics. He was trying to sing the note to match the organ.

Kelvin was of course a remarkable man. We students loved him and respected him most highly for his wonderful accomplishments. His death, natural as it was, came to us as a severe loss, and he was mourned throughout Scotland.

Aid Technical Libraries in Devasted Countries

An appeal is being made by the Committee on International Relations of The American Society of Mechanical Engineers for contributions of technical books and magazines and donations in money with which to restock war-devasted libraries, to modernize those shut off by hostilities from the outside world, and to advance technical progress in countries where it hitherto has not been developed.

The Committee has already received urgent requests for technical literature from China and the Philippines and for a specific list of books from Czechoslovakia.

In order that these requests may be filled and the other objectives of the Committee attained, engineers who have technical books and periodicals to contribute are urged to send at once to the A.S.M.E. (29 West 39th Street, New York 18, N.Y., attention of George A. Stetson, editor) a list of available material, giving title, author, publisher, and date of publication of each volume. The books themselves should not be sent until shipping instructions are received from the Committee, as distribution points may vary with the location of the contributors and of the libraries to which they are to be sent.

Money is needed for the purchase of new books for libraries without financial resources. Contributions may be made in the form of checks drawn to the order of the A.S.M.E. and marked for the International Book Fund. The Committee hopes to provide means by which each book will be marked with the name of the engineer who contributes it, thus promoting international good-will within the engineering profession.

The A.S.M.E. Committee on International Relations is headed by R. M. Gates, president, Air Preheater Corporation, New York, N.Y. Solicitation of books for foreign libraries is under the direction of Joseph Pope, vice-president, Stone and Webster Engineering Corporation, New York, N.Y.

Study of Erosion on North Shore of Long Island

MANY interesting photographs and charts are included in the 52-page report on studies made by the New York State's Joint Legislative Committee Studying the Problem of Checking Erosion Along the North Shore of Long Island.

"The investigations of the committee clearly show," states the report, "that erosion control is a very difficult engineering problem, the science of which is in a changing and unperfected state." The report however includes a number of specific recommendations for various localities and a list of public beach-construction projects considered appropriate for study by the Superintendent of Public Works. The committee makes the general recommendations that the present legislative study be continued and that further state aid be made available for beach protection.

This "Report to the Legislature of the State of New York by the Joint Legislative Committee Studying the Problem of Checking Erosion Along the North Shore of Long Island," may be consulted in the Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

Reclamation Engineers Map Record Program

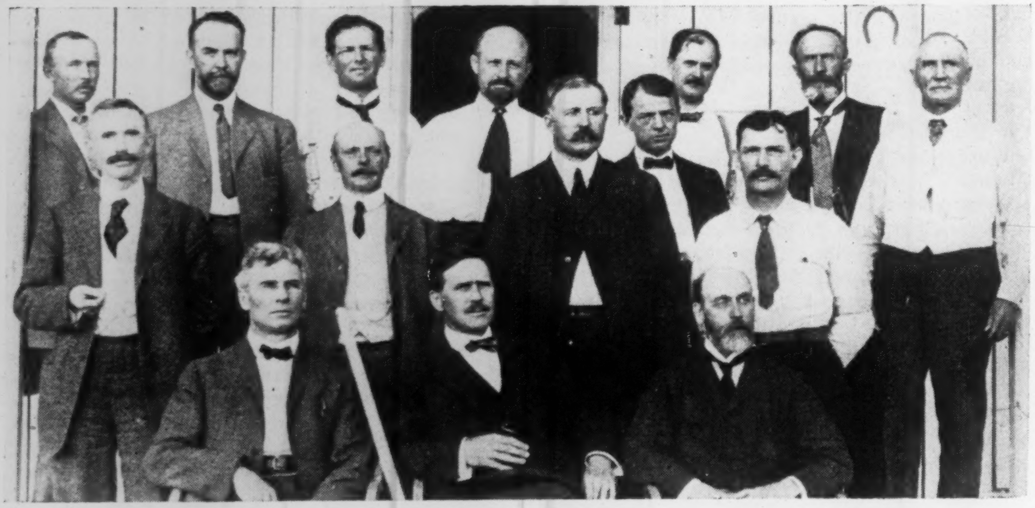
ENGINEERS of the U.S. Bureau of Reclamation from Denver and seven regional offices met with other top Reclamation officials in Washington, D.C., at a five-day conference January 28–February 1, to shape working plans for a $140,000,000 construction program—the largest in the 43-year history of the Bureau. This agency has the full-time job of conserving and utilizing water resources in 17 Western states where irrigation underlies agricultural and industrial prosperity.

Left to Right, Front Row: Goodrich W. Lineweaver, Director of Branch of Operation and Maintenance, Washington, D.C.; Walker R. Young, M. ASCE, Chief Engineer and Director of Branch of Design and Construction, Denver; William E. Warne, Assistant Commissioner, Washington, D.C.; Michael W. Straus, Commissioner, Washington, D.C.; Kenneth Markwell, M. ASCE, Assistant Commissioner, Washington, D.C.; G. S. Ellsworth, Assistant to the Commissioner, Washington, D.C.; and John W. Dixon, Director of Branch of Project Planning, Washington, D.C.

Second Row: H. D. Comstock, M. ASCE, Director, Region VI, Billings, Mont.; R. J. Newell, M. ASCE, Director, Region I, Boise, Idaho; Richard L. Boke, Director, Region II, Sacramento, Calif.; E. O. Larson, Director, Region IV, Salt Lake City, Utah; Kenneth F. Vernon, Acting Progress Control Officer, Washington, D.C.; Glenn D. Thompson, Chief Personnel Officer, Denver; and Robert C. Smith, Labor Relations Officer, Denver.

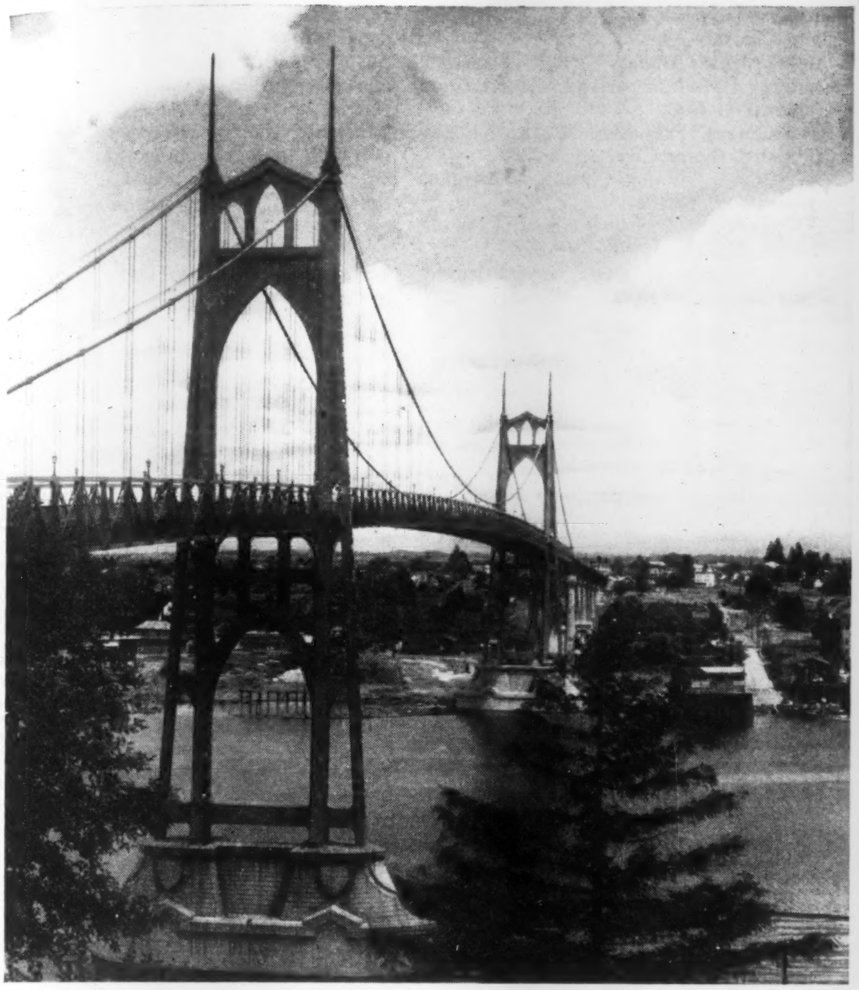
Third row: Q. R. Dungan, Assistant Budget Officer, Branch of Design and Construction, Denver; L. J. Snyder, Assistant Program Control Officer, Branch of Design and Construction, Denver; Eugene D. Eaton, Assistant Director, Branch of Operation and Maintenance, Washington, D.C.; L. R. Douglass, M. ASCE, Assistant Director, Region III, Boulder City, Nev.; L. N. McClellan, Assistant Chief Engineer, Electrical-Mechanical, Denver; Wendell Bramwell, Assistant to Director of Finance, Washington, D.C.; and T. W. Mermel, Acting Assistant to Commissioner—Engineering, Washington, D.C.

Top row: J. L. Cunningham, Assistant to Director, Region I, Boise; F. E. Wilhelm, M. ASCE, Chief Program Control Officer, Branch of Design and Construction, Denver; R. F. Herdman, Chief of Production Control, Branch of Design and Construction, Denver; G. W. Holmquist, Administrative Analyst, Branch of Design and Construction, Denver; John G. Will, Assistant Chief Counsel, Washington, D.C.; Herbert Devries, First Assistant Chief Counsel, Washington, D.C.; A. N. Thompson, Assoc. M. ASCE, Assistant Director, Region V, Amarillo, Tex.; A. O. Babb, Assoc. M. ASCE, Chief of Program Scheduling Section, Washington, D.C.



AN OLD RECLAMATION GROUP, IN CONFERENCE AT MITCHELL, NEBR., JULY 1907

Front Row: Arthur P. Davis, James R. Garfield, Frederick H. Newell. Middle: William H. Code, D. C. Henny, H. N. Savage, N. E. Webster, Morris Bien. Back: L. H. Taylor, C. E. Wells, D. W. Ross, L. C. Hill, Mr. Persons, J. H. Quinton, W. H. Sanders. Messrs. Quinton, Code, and Hill later formed an engineering partnership. At various times Messrs. Davis, Henny, and Hill were officers of the Society. (Photo loaned by J. L. Savage, Hon. M. ASCE)



St. Johns Bridge at Portland, Ore.

The St. Johns Bridge

I.

This frugal span, this faultless arc
Of tempered steel and gray concrete
Unites Willamette's alien shores;
Its white-laned roadway makes the dark
A path of light, an aerial street
Through which the stream of commerce pours.

When cold and clean the light of day
Floods westward from the Cascade range,
St. Helens bathed in rosy flush
And rugged Hood with sun aglow
Behold the Bridge of green and gray
From midnight silence quickly change
To morning traffic's whining rush
Secure above the depths below.

II.

Within the living tissues of a brain
The Bridge of Beauty slowly formed and grew,
An alchemy akin to sun and rain
Changing dry seeds to flowers white and blue.

First comes the dream—and then the master hand
Defines the dream in formulas and forms;
Then great machines from steel and lime and sand
Bring forth the Bridge that conquers time and storms.

The Bridge of Beauty shining through the years!
A song, a symphony, in steel-concrete
The roadway swings between the pointed piers,
The cables curve to lift the hanging street.

The theme is simple: beauty wed to strength;
Long sweeping curves all meeting at a point;
No useless thing in all its height and length;
Exactitude in every weld and joint.

Nothing is left to guess, to hope, to chance:
Each bolt and girder inch by inch is planned,
Stresses and strains and unknown circumstance
Are all forseen by skilful brain and hand.

Gothic and green on airy cables hung,
The Bridge is fused with nature's overtone:
The hills and firs forever green and young
That rise above the river, ripple-blown.

III.

Hail to the Bridge of Beauty, made by Man!
Hail to the patient artist-engineers!
Hail to the men who built the perfect span,
Digging in caissoned depths with blistered hands,
Pouring cement to make the giant piers,
Weaving across the void the mighty strands,
Pounding the cherry-heated rivets in!
Hail to the sweat and blood they spilled,
The gift to life of the men who build,
The price of the praise they win!

And hail to the men who dreamed the Bridge
And strove through years of grim defeat
Till dreams came true and from the ridge
The Bridge flings out its airy street!

IV.

Two hundred feet beneath its arch
The sea-bound traffic comes and goes—
Ships from the seven oceans march
To greet the City of the Rose.

The Bridge of Beauty welcomes them
And bids farewell to each that goes;
His last glance sees her loveliest gem
Who leaves the City of the Rose.

V.

A poem wrought from steel-concrete,
Use and strength and beauty wed!
A path of light, an airy street
Above the barrier river bed.

—Read Bain, 1931

Public Health Association Accredits Schools

A LIST of universities accredited to give the degree of Master of Public Health (Diploma of Public Health in Canada) for the academic year 1946–1947 was recently released by the executive board of the American Public Health Association, on recommendation of the Committee on Professional Education. The list takes into account all institutions from which requests for accrediting were received up to January 25, 1946. Accredited institutions are:

Columbia University School of Public Health
Harvard University School of Public Health
The Johns Hopkins School of Hygiene and Public Health
University of California School of Public Health
University of Michigan School of Public Health
University of Minnesota School of Public Health
University of North Carolina School of Public Health
University of Toronto School of Hygiene
Yale University School of Medicine, Department of Public Health

Additional applications will be acted on in due course.

N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. ASCE

"Balance," mused the professor, "suggests the antithesis of dynamics. So I was intrigued by Guest Professor Nagle's 'dynamical balance.' I suppose, Stoop, that the general term includes things like teeter-totters."

"Not at all, Noah, because teeter-totters are usually symmetrical. There must be gravitational oscillation between two unsymmetrical positions, as in the lift-bridge problem where the asymmetry is created by different slopes of the lift cables at the two rest positions. Computing the period of such a balance is a man-size job, but Joe Kerr should be able to tell us the required counterweight."

"I thot so too," said Joe. "There being no kinetic energy in the system at the rest positions, I equated changes of potential energy of deck and weights:

$$2W(\sqrt{b^2 + 187^2} - \sqrt{b^2 + 13^2}) = 120 \cdot 174$$

where b is the horizontal projection of the lift cable and W one of the counterweights.

At the neutral position, equality of vertical components gives:

$$2W \cdot 80 = 120\sqrt{b^2 + 80^2}$$

It was easy to eliminate W for the moment, but squaring twice to get rid of 3 radicals threatened an octic. Being allergic to optics, I degraded to graphics to find W = 86.8 tons."

"Joe is just allergic to big numbers," taunted Cal Klater. The octic degenerates to

$$108993600b^4 - 769058841600b^2 = 0$$

from which $b = 84$ ft and $W = 87$ tons. If I'd known the problem was set up in integers, I would have solved much easier with pythagorean numbers."

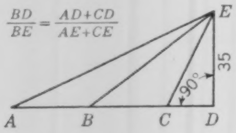


FIG. 1. SET FOR DYNAMICAL BALANCE

"A good hunch, Cal," agreed Professor Nagle. "The problem is really an old one (see *Dynamics of a Particle*, by Tait and Steele, p. 85), but my interest was whetted by the additional condition that all elements be expressed in whole numbers. It is simply the problem of satisfying the 5-point figure $ABCDE$ in integers when $BD(\bar{A}\bar{E} + C\bar{E}) = B\bar{E}(\bar{A}D + CD)$.

"Noah agrees with me that you might be properly confused by a sequel of this kind. Suppose you try to find an integral set for $D\bar{E} = 35$. Anything to add, Noah?"

"Mostly my thanks, Stoop, and my relief that you didn't ask them to compute the time for the lift. Incidentally, Ken Bridgewater has been muttering that the half-period will be about 10 sec for the 174-ft lift, so that the deck will have to be streamlined. He may be interested to know that the maximum velocities can also be expressed in integers (29 ft per sec for the deck and 22 ft per sec for the counterweights) if we agree to make $g = 32.\dot{2}$ $(= 290/9)$."

[*Cal Klaters were Richard Jenney, Claude W. West, May B. Masce (J. S. Kendrick), Walter L. Shilts, Charles Libove and M. W. Huggins. One of the two Canadians has a hydraulic analogy. Stoop Nagle, Guest Professor, is still John L. Nagle.*]

Plans for Research on Building Construction

A SPECIAL COMMITTEE on research has been organized in the Construction Industry Advisory Council. Committee members were appointed by the chairman of the Council, J. C. Stevens, Past-President ASCE, as follows:

Eric Johnston, chairman
Fritz B. Burns, Builder, Los Angeles
H. L. Dryden, Assistant Director, Bureau of Standards
James R. Edmunds, Jr., President, American Institute of Architects, Baltimore
Frederick M. Feiker, Dean, School of Engineering, George Washington University
Roy C. Ingersoll, President, Ingersoll Steel and Disc Division, Borg-Warner Corporation, Chicago
R. G. Kimbell, Affiliate ASCE, National Lumber Manufacturers Association, Washington D.C.
W. A. Klinger, President, W. A. Klinger Company, Sioux City, Iowa
T. S. Rogers, Owens-Corning Fiberglas Corporation, Toledo
E. O. Shreve, Vice-President, General Electric Company, New York, N.Y.
Harry H. Steidle, Manager, Prefabricated Home Manufacturers Institute, Washington, D.C.
Carlile P. Winslow, Assoc. M. ASCE, Director, U.S. Forest Products Laboratory, Madison, Wis.

This committee recently met for the first time to develop a realistic program to stimulate research in the building industry. Discussions indicated that the most immediate need of the industry is research into building methods or techniques, and on assembly of materials and equipment in structures. The committee hopes soon to formulate a definite program and present it to the Council for action.

Baltimore Considers Its Blighted Areas

IN COMMON with many cities, Baltimore has a problem of "blighted" residential areas in the central district; in fact, an area of about 4 square miles has become seriously depreciated. To find a practical solution to this problem, the Commission on City Plan has prepared a 102-page report containing many charts and maps. Included also is an interesting discussion of the low-rent housing problem in general. The Commission includes in its membership Thomas F. Hubbard and W. Watters Pagon, Members ASCE, and ex-officio Nathan L. Smith, M. ASCE, chief engineer of the City of Baltimore.

This report is entitled "Redevelopment of Blighted Residential Areas in Baltimore—Conditions of Blight, Some Remedies, and Their Relative Costs." It can be obtained for $2.50 a copy from the Commission on City Plan, 400 Municipal Building, Baltimore 2, Md. It is also on file in the Engineering Societies Library in New York.

Deflection Theory of Suspension Bridges

OF INTEREST to structural engineers is a 210-page volume *On the Deflection Theory of Suspension Bridges*, by Sven Olof Asplund, printed in English by the Royal Swedish Institute for Engineering Research as *Proceedings*, No. 184. It is dedicated by the author to an American engineer, the late Holton D. Robinson, M. ASCE, "a great engineer and a great friend."

This volume deals with the effect of vertical loads on the main girders of suspension bridges, taking into account the distortions of the system. A principal correction to the fundamental differential equation of the Deflection Theory—for the angular deviation of cable elements—has been amplified.

The first edition was prepared in 1943, but since then several suspension bridge theorists and engineers have submitted valuable discussions, which are included in the present volume, together with other revisions.

The concluding bibliography refers to analysis of, and model tests on, suspension bridges for vertical loads.

New in Education~

Large Building Program for Newark College

INITIATION of a $2,700,000 building program, including a 20-story "educational skyscraper," has been announced by Newark College of Engineering. The expansion calls for three units: first, a 4-story addition to the existing laboratory building; second, rebuilding of the administration offices and classrooms with the addition of three stories (making six in all); and third, the tower, which will adjoin the other two units and rise to a height of 350 ft, making it a prominent building on the Newark skyline.

Construction likewise will be divided into three stages. Unit No. 1, housing the greatly enlarged laboratory facilities and new equipment, will entail an expenditure of $300,000. The second unit, costing $400,000, will include administrative offices, lecture halls, library, museum, cafeteria, swimming pool, auditorium, and gymnasium. Unit No. 3, the two-million-dollar tower, will contain classrooms, student activity areas, club rooms for professional engineering societies and college organizations, faculty and student lounges, and a coffee shop. A glass solarium will top the structure and may eventually be used in connection with radar experimentation.

* * * *

Summer Surveying Camp for University of Illinois

TO PROVIDE summer surveying training for University of Illinois students, the University has leased Camp Rabideau in the Chippewa National Forest in northern Minnesota. Civil engineering students between their freshman and sophomore years will spend eight weeks there. Other engineering students also may attend.

Five reasons for the camp were stated: (1) areas available in Illinois are unsuitable for topographic and route surveying (2) no bodies of water are available for hydrographic surveying, and no suitable streams for gaging; (3) periods into which surveying instruction at the campus must be divided do not permit real surveys to be made; (4) it now is necessary to divide students into small squads instead of parties, as in actual surveying operations; (5) stormy weather often interferes with surveying instruction at Urbana-Champaign.

NEWS OF ENGINEERS

Personal Items About Society Members

Nathaniel C. Saxe has severed his connection as field engineer for the Kellex Corporation, of New York, N.Y., in order to establish a consulting practice, specializing in the design, construction, and supervision of industrial plants, buildings, and public works. Temporarily his office will be in the Brooklyn Eagle Building, 303 Washington Street, Brooklyn, N.Y.

Walter L. Dickey, until lately a commander in the Civil Engineer Corps of the U.S. Naval Reserve, has accepted the position of chief engineer for the San Francisco contracting firm of Erbentraut and Summers.

Frederick R. Muhs, Sr., has retired as president of the San Francisco Bridge Company, with which he has been connected since 1919. His son, Frederick R. Muhs, Jr., formerly general superintendent of the organization, has been elected vice-president of the company and will continue to direct its field work.

Ralph A. Tudor is now in charge of foreign operations for the Morrison-Knudsen Company in San Francisco. His headquarters will be in that city, though he will soon make a trip to India for the organization. Until lately Colonel Tudor was district engineer for the U.S. Corps of Engineers at Portland, Ore.

Richard J. Kroc has been released from active duty in the Corps of Engineers, U.S. Army, after four years of service. During part of this period he was engaged in topographic operations overseas, holding the rank of captain. At present he is with Crocker and Ryan, consulting engineers of Denver, Colo.

Horace A. Johnson, design engineer for the U.S. Engineer Office at Sacramento, Calif., where he is working on dam structures, recently received an Army citation for his accomplishments at Hill Field, Camp Haan, March Field, and Palm Springs, "...thus contributing to making available military installations essential to the war effort."

Russell A. Hall has been appointed assistant city engineer of San Diego, Calif., as a result of a series of comprehensive examinations given to candidates for the position. Mr. Hall has had municipal engineering experience with the cities of Flint and Detroit, Mich., and Toledo, Ohio. More recently he has been with the Ryan Aeronautical Company, of San Diego, on the design of jet-turbo driven planes.

David M. Greer has resigned as engineer in charge of the District Laboratory, U.S. Engineer Office at Galveston, Tex., in order to establish a consulting engineering practice with Bramlette McClelland in Houston, Tex. The firm will be called Greer and McClelland and will have offices in the Second National Bank Building, Houston 2.

Mason C. Prichard, Colonel, Corps of Engineers, U.S. Army, has been awarded the Legion of Merit medal of the War Department for his "... orderly solution of construction problems Army-wide in scope ...." Colonel Prichard is now on duty in the Office of the Commanding General, Army Service Forces.

Edward H. Lesesne has returned to this country after nearly three years of overseas service in the Air Corps, in which he had the rank of captain, and has accepted a position with the Tennessee Valley Authority at Murphy, N.C.

Herbert D. Vogel, colonel, Corps of Engineers, U.S. Army, has been named district engineer for the Buffalo (N.Y.) district of the U.S. Engineer Office. Colonel Vogel recently returned from Tokyo.

Edward H. Feldmann has been appointed city engineer of New Rochelle, N.Y., and John N. Calkins will serve Ironwood, Mich., in a similar capacity. Both were recently released after serving in the Seabees, Mr. Feldmann having had the rank of commander and Mr. Calkins that of lieutenant.

S. F. Borg announces that he and B. J. Kaganov have formed the consulting engineering firm of Borg, Kaganov and Associates, with offices in Annapolis, Md., and New York City. The new firm will specialize in civil and aeronautical engineering structures and flight testing. Mr. Borg was formerly assistant professor of civil engineering at the University of Maryland.

Simon Perliter, of Los Angeles, Calif., was recently awarded the Asiatic-Pacific Campaign Medal for "outstanding technical service in forward areas," as well as a War Department citation for Exceptional Civilian Service. During Mr. Perliter's tour of duty in Hawaii, where he was a civilian employee with the War Department, he served a term as president of the Hawaii Section of the Society.

Harold A. Schaill has joined the staff of the Whiting Corporation in Chicago, Ill. Until lately he was a captain in the U.S. Army, engaged in overseas service.

Emil S. Birkenwald is now engineer of bridges for the Southern Railway Company, Western Lines, with headquarters at Cincinnati, Ohio. He was formerly assistant engineer of bridges for the company at Knoxville, Tenn.

L. H. Clouser has severed his eleven-year connection with the TVA in order to go into partnership with Campbell Wallace, Knoxville consultant. The new firm, specializing in sanitary, civil, and hydroelectric work, will have offices in the Mercantile Building in Knoxville, Tenn.

A. R. Nieman, formerly assistant general manager for the Kaiser Company at Portland, Ore., has established a general contracting practice in Vancouver, Wash., under the name of Nieman Company, Inc.

William A. Hardenbergh has returned to the staff of the periodical, *Public Works*, in the capacity of vice-president and editor, after five years in the Sanitary Corps of the U.S. Army. He had the rank of colonel.

Clarence A. Hamlin, who was recently released from the U.S. Army with the rank of lieutenant colonel, has accepted the position of office engineer in the bureau of construction of the Illinois Division of Highways.

George W. Simons, Jr., is now planning engineer for Pensacola, Fla.

J. S. Waldrep has established an engineering practice in Oklahoma City, Okla., where he will specialize in municipal and structural engineering. Prior to entering the Civil Engineer Corps of the U.S. Naval Reserve, from which he was recently released, Commander Waldrep was city engineer for Oklahoma City.

C. H. Cotter, rear admiral, Civil Engineer Corps, U.S. Navy, has been appointed vice-chief of the Materials Division, in which capacity he will assist Admiral Moreell. He was previously in charge of operations in the Pacific for the Bureau of Yards and Docks.

Thomas M. Robins has accepted the position of consulting engineer for the Port of Portland (Ore.) Commission. General Robins recently retired as Deputy Chief of Engineers after forty years of Army service.

Max C. Tyler will serve as technical adviser to the city of Memphis and to Shelby County, Tennessee. General Tyler recently retired as president of the Mississippi River Commission.

George F. Nicholson is now on terminal leave from the Civil Engineer Corps of the U.S. Naval Reserve, in which he served with the rank of captain. After a four-month vacation he will reopen his consulting offices in Los Angeles, Calif., and Washington, D.C., continuing his policy of specializing entirely in harbor and waterfront engineering and construction matters. Until recently he was public works officer and officer in charge of construction for the San Francisco Naval Shipyard.

Thomas B. Larkin, major general, Corps of Engineers, U.S. Army, has been appointed Quartermaster General of the Army. He was formerly commanding general of the Second Service Command at Governor's Island, N.Y.

Calvin V. Davis, vice-president of the Frederic R. Harris Engineering Corporation, will be in charge of the new office that the organization has just opened in Atlanta, Ga. Mr. Davis has recently been in charge of the corporation's work in the South, with headquarters at Knoxville, Tenn.

Donald D. King announces that he is entering the industrial advertising field, doing agency work at 160 Fifth Avenue, New York City, under the name of King Advertising Services. Mr. King was formerly art editor of Civil Engineering, but left in October 1943 to become editor of *Aviation Engineer Notes*, the publication of Army Air Forces Headquarters, in Washington, D.C. For the past year he has been assistant editor of *Construction Methods*.

Lewis A. Schmidt, Jr., of Chattanooga, Tenn., has established an engineering partnership in that city, with John W. Peerson and Aake F. Hedman, under the firm name of Schmidt, Peerson, and Hedman.

Calvin C. Oleson has returned to his former post as associate professor of civil engineering at South Dakota State College, after serving as a captain in the Corps of Engineers, U.S. Army.

Thomas R. Jacobi, who was recently released from the Civil Engineer Corps of the U.S. Naval Reserve, has accepted the position of city engineer of Anderson, Ind. His rank at the time of separation was that of lieutenant commander.

LeRoy M. Davis is now assistant hydraulic engineer for the Public Utility Engineering and Service Corporation, of Chicago, Ill. He was previously chief engineer for the South Carolina Public Service Authority at Columbia, S.C.

John A. Dominy, commander, Civil Engineer Corps, U.S. Naval Reserve, has been appointed assistant public works officer and assistant officer in charge of construction at the Marine Air Station at Cherry Point, N.C.

Philip G. Bruton, brigadier general, Corps of Engineers, U.S. Army, has been appointed acting division engineer of the newly created Western Ocean Division, which will be in charge of work on our island bases in the Pacific. General Bruton is also division engineer for the Pacific Division at San Francisco, Calif.

Marvin O. Kruse, until lately a captain in the Corps of Engineers, U.S. Army, and Herman Sidwell Smith have been admitted to partnership in the Stanley Engineering Company, of Muscatine, Iowa. Mr. Smith was formerly associate engineer for the organization.

Wallace W. Sanders, previously construction engineer for the Henry Bickel Company, Inc., of Louisville, Ky., has become city engineer of Louisville.

George F. Hopkins, captain, Corps of Engineers, U.S. Army, is now chief of the operations division and contracting officer for the U.S. Engineer Office at Seattle, Wash.

Lee G. Warren has severed his connection as administrative manager for the Tennessee Eastman Company at Knoxville, Tenn., in order to join the staff of Ebasco Services in New York City. He will be general construction manager of all the organization's operations.

George M. Stiers has accepted a position with the Amis Construction Company, general contractors of Oklahoma City, Okla. He was recently separated from the Civil Engineer Corps of the U.S. Naval Reserve, with the rank of lieutenant.

Leonard O. Williams, Jr., has returned to his post as director of the division of public health engineering and sanitation in the Wyoming State Department of Health after serving as a major in the Sanitary Corps of the U.S. Army.

David Standley, who was recently released from the Civil Engineer Corps of the U.S. Naval Reserve, with the rank of commander, is now with C. Frederick Wolfe, engineer of Brooklyn, N.Y.

John B. Snethlage has been engaged by the J. G. White Engineering Corporation as the hydroelectric engineer of a group of power experts, which will assist the Chinese government in the rehabilitation of its power facilities in Manchuria and on the island of Formosa. He was formerly associated with Col. F. W. Scheidenhelm, New York City consultant.

E. B. Myott, colonel, Corps of Engineers, U.S. Army, has rejoined the staff of Fay, Spofford and Thorndike, with headquarters in the Boston office. Two other members of the Society—Lt. Col. Leon B. Turner and Capt. Nathaniel N. Wentworth, Jr.—have also returned to their positions in that office.

DECEASED

Ernest Henry Brownell (M. '04) captain, Civil Engineer Corps, U.S. Navy (retired), Newport, R.I., died on December 18, 1945. His age was 78. Captain Brownell was commissioned in the Civil Engineer Corps of the Navy in 1902, and later rose through the grades to captain, attaining that rank in 1922. He was retired in 1929. For a time Captain Brownell was head of the department of yards and docks at the Cavite Navy Yard in the Philippines. During the first World War he served in France, where he worked on the establishment of aviation bases. Other important Navy construction projects, on which he was engaged, included the Puget Sound dry dock, the Portsmouth (N.H.) bridge, and the Pearl Harbor fuel plant.

Charles Henry Covey (Assoc. M. '15) president and manager of the Dibblee Construction Company, Ottawa, Canada, died on February 9, 1946. Mr. Covey, who was 63, was educated in the United States and spent his early engineering career here. He was superintendent for the Fraser, Brace Company on various construction projects, later going to Montreal as assistant to the president of the company. He had been connected with the Dibblee Construction Company for a number of years—since 1931 in the capacity of president and manager.

Francis Trenholm Crowe (M. '15) famous builder of dams and Honorary Member of the Society, died suddenly in Redding, Calif., on February 26, 1946. He was 63. A biographical sketch of his career and a photograph appear in the "Society Affairs" section of this issue.

Leonard Henry Davis (M. '09) consulting engineer for the Union Carbide and Carbon Corporation, New York, N.Y., died at his home in that city on February 19, 1946. Mr. Davis, who was 73, spent his early career with the Boston Transit Commission. In 1903 he became manager and chief engineer of the Michigan and Lake Superior Power Company at Sault Ste. Marie, Mich. This company subsequently became the Michigan Northern Power Company, a subsidiary of the Union Carbide. In 1926 Mr. Davis was elected vice-president and director of the Michigan Northern Power Company, and in 1929 president. He was also vice-president of the New-Kanawha Power Company, for which he designed and supervised the construction of the large hydroelectric power development on the Kanawha River near Charleston, W.Va.

Frank Keys Duncan (M. '20) retired engineer of Baltimore, Md., died on February 20, 1946, at the age of 71. Mr. Duncan spent much of his career in the service of the City of Baltimore. He was assistant engineer in the Sewer Department from 1897 to 1900; assistant engineer in the City Engineer's Department from 1900 to 1911; and with the Paving Commission of Baltimore from 1911 to 1923 in a variety of capacities. Later he was assistant chief engineer and chief engineer in the Department of Public Works.

John Harrison Foss (Assoc. M. '10) president of the Maui (Hawaii) Electric Company and manager of the East Maui Irrigation Company, died at his home in Hamakuapoko, Hawaii, on January 5, 1946. His age was 67. Born and educated in California, Mr. Foss first went to Hawaii in 1904. From 1907 to 1918 he was associate professor of civil engineering at Stanford University, returning to Maui in the latter year to resume his affiliation with the Maui Agricultural Company and the East Maui Irrigation Company. Later he reorganized and became president of the Maui Electric Company. His career was centered in the industrial development of Maui, particularly in scientific research of the island's water supply. One of his outstanding achievements was the completion of a major ditch system for the island.

Herbert Richard Hodosh (Jun. '40) lieutenant, Air Force, U.S. Army, died in Manila, P.I., on November 11, 1945. Mr. Hodosh was 26, and an alumnus of the College of the City of New York, class of 1940. Before entering the Army (in 1943) he was a junior engineer with the New York City Board of Water Supply. His home was in New York.

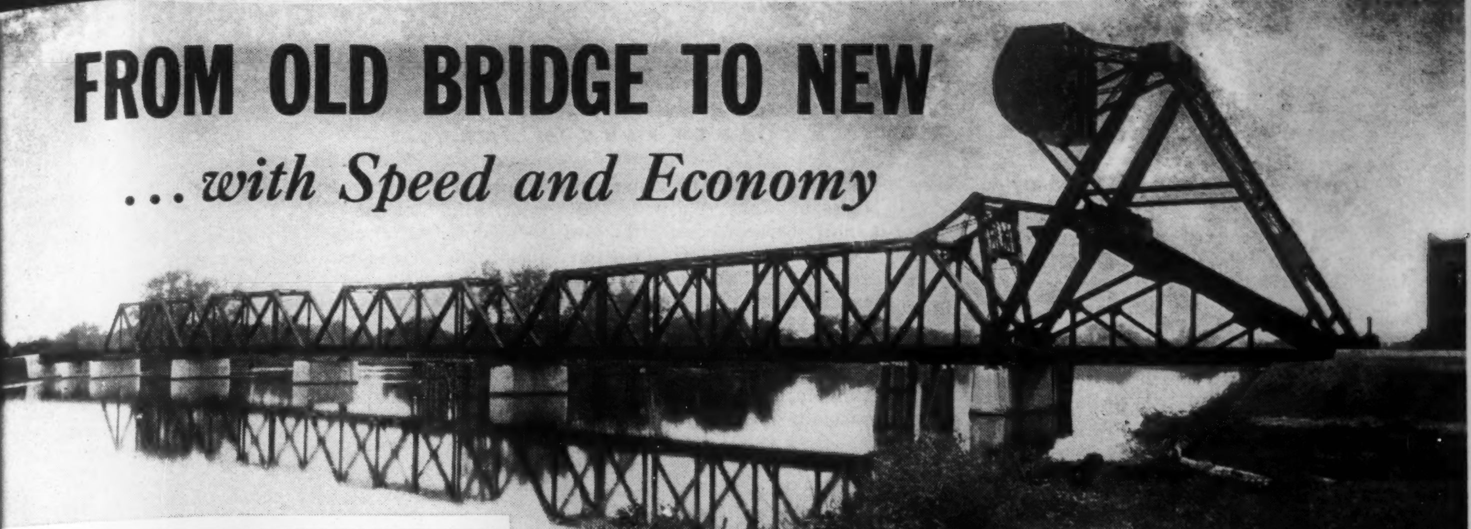
Robert Hoffmann (M. '04) Honorary Member of the Society and former Director, died in Cleveland, Ohio, on March 2, 1946, at the age of 80. The "Society Affairs" department of this issue contains a biographical sketch and photograph of Mr. Hoffmann.

Charles Porterfield Kahler (Assoc. M. '17) chief electrical engineer for the Union Pacific Railroad, Omaha, Nebr., died on February 25, 1946, as a result of injuries suffered in an automobile accident near Santa Ana, Calif., on the preceding day. Mr. Kahler, who was 65, had spent his entire career in railroad work. He joined the staff of the Union Pacific in 1906, and had been chief electrical engineer since 1931.

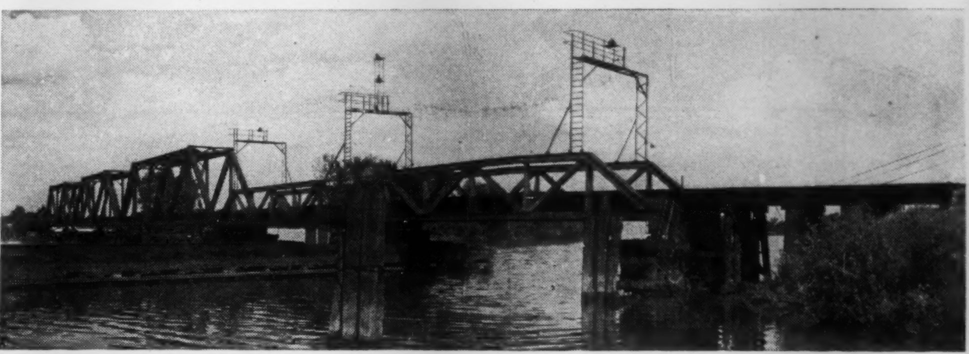
John Edward Kemp (M. '12) civil engineer and supervisor of training for the Walworth Company, Kewanee, Ill., died there on January 19, 1946, at the age of 68. From 1902 to 1904 Mr. Kemp was city engineer of Kewanee, and from 1904 to 1917 civil engineer for the Walworth Company. He then went to France for wartime service as a construction engineer in the Ordnance Department. From 1919 to 1931 he was superintendent of maintenance for the Walworth Company, and from 1932 on director of training. During the recent war he built a shell plant and numerous other structures for the Walworth Company at Kewanee, and was resident engineer in charge of construction on a steel plant

FROM OLD BRIDGE TO NEW

... with Speed and Economy



NEW SAGINAW RIVER BRIDGE, looking downstream. It is 738 feet, 7 inches long between abutment back walls, and comprises two new deck plate girder spans, each 62 feet, 3 inches long; three through truss spans (106 feet, 10 inches, 111 feet, 6 inches; and 125 feet, 9 inches long, respectively); one 172-foot bascule span with tower span 82 feet, 4 inches long. The three truss spans, reclaimed from the former bridge, were cut loose from the old structure and shifted as a 470-ton unit by means of rollers supported on falsework decking.



← **LOOKING UPSTREAM** at the new Abt-type bascule unit. Upon completion of the 82-foot, 4-inch "A" type, counterweight tower span, the 172-foot bascule leaf was erected in open position so as not to interfere with river navigation. Old swing span in background.

↑ **OLD BRIDGE** looking downstream. Its three through truss spans were flanked by two swing spans built in 1893. Contrast the outmoded swing span and divided channels, each about 65 feet wide, with the new, clean-cut bascule span which provides 150-foot navigation clearance.

ONLY 14 hours' traffic interruption was required to put in operation this new Saginaw River Bridge at Saginaw, Michigan, for the Pere Marquette Railway Company. It replaces an older structure which was located 37 feet upstream and of inadequate capacity excepting for three through truss spans, originally fabricated, in 1923, by American Bridge. These three spans were reclaimed and used in the new bridge. Minimum traffic interruption was achieved by completely erecting all new steelwork prior to shifting the reclaimed spans to the new alignment.

The construction of the new bridge—ingeniously planned and engineered for modern E-72 loading—incorporates newly fabricated plate girder approach and Abt-type bascule units, supplemented by the three reclaimed truss spans.

The entire ready-for-service superstructure was under contract to American Bridge Company. It involved fabrication of 710 tons of new steel; the erection of 1,247 tons of steelwork and other materials, including machinery parts, counterweight, operator's house and electrical equipment; and the placement of ties, rails, guard timbers, etc., for track decking of the bascule unit. Also under contract was the complete removal, cutting into blast furnace scrap lengths, and loading on cars of the two swing spans from the old bridge.

Whenever you plan roadway improvements to meet the increasing demands of heavy power, traffic density and high-speed operations, the wide experience of American Bridge Company is at your service.

AMERICAN BRIDGE COMPANY

General Offices: Frick Building, Pittsburgh, Pa.

District Offices in: Baltimore · Boston · Chicago · Cincinnati · Cleveland · Denver · Detroit
Duluth · Minneapolis · New York · Philadelphia · St. Louis

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

erected for the Navy at Washington Park, Ill.

Burr Robert Kulp (M. '43) chief engineer for the Chicago and North Western Railway, Chicago, Ill., died at his home in Evanston, Ill., on February 27, 1946. Mr. Kulp, who was 62, had spent his entire career with the Chicago and North Western Railway, with which he became connected in 1905. Promoted through the various grades, Mr. Kulp became chief engineer in 1940. At the time of his death he was, also, chief engineer of the Chicago, St. Paul, Minneapolis, and Omaha Railway.

Armour Cantrell Polk (M. '13) consulting engineer of Birmingham, Ala., died on March 1, 1946, at the age of 66. Colonel Polk was Director of the Society from 1940 to 1942, and was serving a term as Vice-President at the time of his death. A biography and photograph of Colonel Polk appear in the "Society Affairs" section.

Albert Lyon Scott (M. '37) president of Lockwood, Greene Engineers, Inc., New York, N.Y., died at his home in Chappaqua, N.Y., on March 2, 1946. Mr. Scott, who was 67, became connected with Lockwood, Greene and Company, a Boston firm specializing in the design and construction of textile mills and industrial buildings, in 1900. Later the name of the company was changed, and its headquarters were established in New York. Mr. Scott was, successively, director, treasurer, and vice-president of the firm, and he had been president since 1926. He was widely known as a leader in church and civic affairs, and during the first World War served on the committee on supplies of the Council of National Defense.

Valentine Bernard Siems (M. '26) retired civil engineer, died at his home in Jackson Heights, N.Y., on February 15, 1946, at the age of 58. Except for a period as construction engineer for the U. S. Army during the first World War, Mr. Siems was with the Baltimore (Md.) Water Department from 1909 to 1927. During the last four years of this period he was president of the Water Board and water engineer for the city. He then (1927) became vice-president, chief engineer, and general manager of the North American Waterworks Corporation; and from 1931 until his retirement a few years ago he was head of the New York consulting firm of V. Bernard Siems. Offering his services to the government at the outbreak of the second World War, Mr. Siems planned the water supply work at Camp Kilmer and other Army bases.

Carroll Rose Thompson (M. '20) chief engineer for the Philadelphia Department of Wharves, Docks, and Ferries, Philadelphia, Pa., died at his home in that city on February 21, 1946. Mr. Thompson, who was 60, spent practically his entire career with the Department of Wharves, Docks, and Ferries, having gone there as a draftsman in 1909. In 1920 he was made assistant director of the Department in complete charge of all engineering work, and he had been chief engineer since 1920.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From February 10, to March 9, 1946, Inclusive

ADDITIONS TO MEMBERSHIP

Aguilar V, Juan Francisco (Jun. '45), Asst. Research Engr., Materials Laboratory, Univ. of California, Berkeley (Res. 1945 Franklin St., San Francisco), Calif.

Arn, John Arthur Melvin (Jun. '45), Ensign, CEC, U.S.N.R.; 301 Fayette St., Belle Vernon, Pa.

Barnett, Nallie Beckham (Assoc. M. '46), Constr. Engr., Bureau of Yards and Docks, U.S.N., Naval Ammunition Depot Shumaker (Res., 604 Clifton St.), Camden, Ark.

Bedell, Allen Stanley (M. '46) (J. E. Sirrine & Co., Engrs.), Box 960, Greenville, S.C.

Bickel, Arthur Daniel (Assoc. M. '46), 301 South East 19th St., Fort Lauderdale, Fla.

Borucov, Elhanan (M. '45) Chf. Engr., Keren Kayemeth Leisrael Ltd. (Jewish National Fund), Box 283, Jerusalem, Palestine.

Brevoort, Henry Armstrong (M. '46), Prin. Engr., North Atlantic Div., Corps of Engrs., 270 Broadway (Res., 21 East 10th St.), New York, 3, N.Y.

Burzell, Linden Robert (Jun. '45), Ensign, CEC, U.S.N.R.; 1459 Carmelina Ave., Los Angeles 25, Calif.

Carley, Milner Walter (M. '46), Prin. Asst. Engr., County Surveyor's Dept., 367 Court House (Res., Dayton's Bluff Station, Route 4), St. Paul 6, Minn.

Chao, Hwa (Jun. '46), Associate Engr., Ministry of Communications, China, Chungking, China. (Res., 301 Millaudon St., New Orleans, La.)

Cohen, Edward (Jun. '46), Junior Engr., Hardesty & Hanover, 101 Park Ave. (Res., 530 Furnald Hall, Columbia Univ.), New York, N.Y.

Cohen, William Martin (Jun. '46), Draftsman, Whitman, Requardt & Associates, 1304 St. Paul St. (Res., 3023 West Garrison Ave.), Baltimore, Md.

Chase, Dwight Atwater (M. '46), Capt., U.S. Coast Guard, Asst. Chf. of Civ. Eng. Div., Washington 25, D.C.

Chorpening, Claude Henry (M. '45), Col., Corps of Engrs., U.S. Army, Office, Chf. of Engrs., Washington, D.C. (Res., Apt. 401, Arlington Village, Arlington, Va.)

Denton, Clifford Imerson (Assoc. M. '45), 19715 Gaylord Ave., Detroit 19, Mich.

Esterbrooks, Robert Charles (Jun. '45), Ensign, CEC, U.S.N.R.; 126 North 4th St., Colton, Calif.

Farrell, James Edward (Jun. '45), Ensign, CEC, U.S.N.R.; 1051 Nerced Ave., Berkeley, Calif.

Farrow, Ernest Elliott, Jr. (Assoc. M. '45), Vice-Pres. and Chf. Engr., Farrow, Inc., Engrs. and Builders, 3162 Kenwood Ave., Indianapolis 8, Ind.

Fehrman (Vega), Juan Eduardo (Jun. '46), Engr., Empresa Nacional de Electricidad, S.A., Ramon Nieto 920. of 364, Santiago (Res., Casilla F 2, San Bernardo), Chile.

Fowler, Everett Wheeler (Assoc. M. 46), Engr., National Board of Fire Underwriters, 85 John St., New York 7, N.Y.

Goodpasture, Robert Carrol (Jun. '46), Ensign, U.S.N.; 211 Hewett Rd., Wyncote, Pa.

Hardy, Robert Jay (Assoc. M. '46), Senior Civ. Engr., State Dept. of Public Works, State Office Bldg., Albany 1 (Res., 19 Pineview Ave., Delmar), N.Y.

Harris, John Newton (Assoc. M. '46), Lt. Col., Corps of Engrs., U.S. Army; 412 West Franklin St., Richmond, Va.

Hubbard, Willis Wilkinson (M. '46), Archt. (Willis Hubbard-Clifford F. Hyland), 723 Gas Elec. Bldg., Rockford, Ill.

Hufty, Myrle Renwood (Assoc. M. '46), Constr. Supervisor, Inter-American, U.S. Public Roads Administration, Apartado 86, Guatemala City, Guatemala, C.A.

Johnson, Paul Marion (M. '46), Constr. Cost Examiner, Federal Housing Administration, Federal Bldg. (Res., 814 North Rodney), Helena, Mont.

Joppert Da Silva, Mauricio (M. '46), Prof. of Sea Ports, Impvt. of Rivers and Canals, Escola Politecnica do Rio de Janeiro (Res., Praga Engenio Jardim 35 Copacobana), Rio De Janeiro, Brazil.

TOTAL MEMBERSHIP AS OF MARCH 9, 1946

Members	6,370
Associate Members	8,160
Corporate Members	14,530
Honorary Members	36
Juniors	6,593
Affiliates	78
Fellows	1
Total	21,238
(March 9, 1945	20,609)

Kaleschke, Emil Julius (Assoc. M. '46), Asst. Civ. Engr., City of Oakland, 712 City Hall (Res., 830 MacArthur Blvd.), Oakland, 10, Calif.

Kibblewhite, Gordon Victor (Assoc. M. '46), Officer-in-Chg. of Works, British Admiralty, H.M. Dockyard, Bermuda.

King, Harry Lane, Jr. (Jun. '45), 2d Lt., Corps of Engrs., U.S. Army, Company A, 43d Engr. Constr. Battalion, Army Post Office 994, Care, Postmaster, San Francisco, Calif.

Lake, John Owen Arthur (Assoc. M. '45), Engr. (Civ.), The British Steel Piling Co., Ltd., 10, Haymarket, London S.W.I. (Res., "Briarcroft," Thorpe End, Norwich), England.

Lally, James Patrick (Jun. '45), Ensign, CEC, U.S.N.R.; Somers, Mont.

Landers, Walter (Assoc. M. '46), Associate Highway Engr., Div. of Highways, State Dept. of Public Works, Public Works Bldg. (Res., 1940 Vallejo Way), Sacramento 14, Calif.

Ledbetter, Isaac Lyman, Jr. (Assoc. M. '45), Civ. Engrs., Civil Aeronautics Administration, 1015 Fourteenth St., N.W., Washington, D.C. (Res., 855 North Larrimore St., Arlington, Va.)

Lee, Paul Bryan (M. '46), Section Chf., Pavement and Railroad Section, Ninth Service Command Engrs., Fort Douglas (Res., 1102 East 1st South, Salt Lake City), Utah.

Lo, John Penchang (Jun. '46), Care, Morris Knowles, Inc., 1312 Park Bldg., Pittsburgh, Pa.

MacDonald, Frank Whitmore (Assoc. M. '46), Associate Prof., School of Civ. Eng., Tulane Univ., New Orleans, La.

McCormick, Caleb Walter, Jr. (Jun. '45), Ensign, CEC, U.S.N.; 2480 Lincoln Ave., Altadena, Calif.

McFarland, Cecil Warren, (Jun. '45), Asst. Civ. Engr., U.S.N., Roosevelt Roads Naval Base, Navy 1506, Care, Fleet Post Office, New York, N.Y.

McFarland, William Henry (Assoc. M. '46), Cons. Engr.; Senior Engr., Broome County, County Office Bldg., Binghamton, N.Y.

Mitchell, Peter Franklin (Assoc. M. '46), With Sanborn & Fitzpatrick, 101 Park Ave. (Res., 21 Claremont Ave.), New York 27, N.Y.

Monary, Robert Emmett (Jun. '45), Ensign, CEC, U.S.N.R.; R.F.D. 2, Box 480, Bellevue, Wash.

Moore, Lawrence Dudley (Assoc. M. '46), Engr. Aide, Grade V, Los Angeles County Surveyor and Engr., 700 Hall of Records (Res., 2635 Ivanhoe Drive), Los Angeles 26, Calif.

Morrison, John Haddow (M. '45), Morrison Eng. Co., 627 Monroe Ave., Helena, Mont.

Myers, Hu Blakemore (Assoc. M. '46), Dist.

78,000 GALLONS PER MINUTE

The five neat, space saving G-E synchronous motors in this chemical-plant pumping station have set a record for dependable, low-cost service.

. . . with motors that have plenty of style!

The plant engineers who laid out this new Kentucky pumping station wanted motors with two distinct features—dependable, economical operation and sleek, modern appearance.

Municipalities aren't the only ones who must depend completely on reliable, large-scale water-pumping service. Many process industries rely on a continuous supply of water to keep output at peak level. This industrial plant, for example, required a flow of 78,000 gpm, pumped against a head of 180 feet. Most of the water was to be used for chemical processing on a continuous basis. Any lengthy interruption in service would jam production disastrously. In addition to getting the utmost reliability, the plant engineers wanted motors that would look as well as they behaved.

We were asked to help in preparing motor specifications. The heavy pumping load involved, plus the need for power-factor correction, pointed to the use of synchronous motors. G-E engineers recommended a 900-hp, 900-rpm, hollow-shaft synchronous motor for each of the five pumps. To meet an external thrust of 40,000 lb, two special angular-contact, ball-type thrust bearings were furnished with each motor. An important safety feature was the addition of non-reverse ratchets to prevent reverse rotation of the pumps, caused by turbine action, when the motors were shut down.

MOTORS GIVE TOP PERFORMANCE

Two years after installation, we checked on the motors' performance. During this period, there were no shutdowns for major repairs. Very little regular maintenance had been required. Eye appeal of the installation was strong, too. The motor lines were neat and uncluttered, making the pumping station's general appearance highly attractive.

Here is a typical example of G-E engineering experience teamed up with G-E design techniques to produce synchronous motors that meet the highest standards of appearance and performance. If your pumping requirements call for an unusual combination of motor characteristics, you will do well to consider G-E synchronous motors. Ask your nearest office for complete details. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

750-256-8030

SYNCHRONOUS MOTORS

Engr., State Dept. of Public Works, Capitol Bldg., Baton Rouge (Res., Colfax), La.

Neal, Willie Grey (Jun. '45), With U.S.N.; Route 1, Lebanon, Tenn.

Orr, Joseph Anderson, Jr. (Jun. '45), Engr., R. P. Farnsworth & Co., Inc., Box 74, Houston (Res., Box 145 FE, College Station), Tex.

Pearson, Russell Wayne (Jun. '45), Ensign, U.S.N.; 1126 Olympic Ave., Bremerton, Wash.

Posner, Harry (M. '46), Asst. Engr. of Structures, New York Central System, 466 Lexington Ave., Room 948, New York 17, N.Y.

Riddle, Kemble L. (Assoc. M. '46), Structural Engr., Blaw-Knox Co., Blawnox (Res., 954½ Kennebec St., Pittsburgh 17), Pa.

Robbins, Curtis Reed (Jun. '45), Ensign, U.S. N.R.; 1724 Mt. Diablo Ave., Stockton, Calif.

Rodgers, James Louis, Jr. (Jun. '45), Asst. Civ. Engr., U.S.N.R., Constr. Battalion Maintenance Unit 540, Care, Fleet Post Office, New York, N.Y.

Rome, George Irving (Jun. '46), Engr., The F. K. Vaughn Building Co., 708 First National Bldg., Hamilton, Ohio. (Res., 8760 Ninety-fourth St., Woodhaven 21, N.Y.)

Salovaara, Jorma Julius (Assoc. M. '45), 2d Lt. Air Corps, U.S. Army; 3913 Oakpark Pl., Cincinnati 9, Ohio.

Schobinger, Charles Webster (Jun. '45), Ensign, U.S.N.; 9241 South Damen, Chicago 20, Ill.

Schueneman, Jean Julian (Jun. '45), Ensign, CEC, U.S.N.R., 143rd Naval Constr. Battalion, Care, Fleet Post Office, San Francisco, Calif.

Slack, Robert Eugene (Assoc. M. '46), Cons. Engr., (Civ.), 3416 Broadway, West Palm Beach, Fla.

Spurzem, Raymond (Assoc. M. '46), Res. Maintenance Engr., State Highway Dept., Kalispell, Mont.

Stewart, Dueray Leroy (Assoc. M. '46), Asst. Civ. Engr., City of Oakland, 701 City Hall, Oakland 12, Calif.

Tarran, David Gordon (Jun. '45), Ensign, CEC, U.S.N.R.; Rural Route 2, Irving, Ill.

Trowbridge, William Perkins (Jun. '45), Ensign, U.S.N.R.; 2129 Lyon St., San Francisco 15, Calif.

Turnbull, John Gordon (M., '46), Pres., J. Gordon Turnbull, Inc., 2630 Chester Ave., Cleveland 14, Ohio.

Umble, George Richard (Jun. '45), Ensign, CEC, U.S.N.; 1542 Lincoln St., Berkeley, Calif.

Van Gorp, Dick, (M. '46), Chf. Subway Engr., Dept. of Subways & Superhighways, City of Chicago, Room 466, 20 North Wacker Drive (Res., 6615 North Ponchartrain Blvd.), Chicago 30, Ill.

Vignola, Raul (Jun. '46), Asst. Engr., Corporacion de fomento de la produccion, 120 Broadway, New York 5, N.Y.

White, Elmer James (M. '45), Engr. and Co-Partner, MacRae Brothers, 2733 Fourth Ave. South, Seattle 4, Wash.

Wikle, Kenneth Clinton (Assoc. M. '46), Structural Engr., Twentieth Century-Fox Film Corp., Beverly Hills (Res., 10476 Kinnard Ave., Los Angeles 24), Calif.

Wilkison, Harrison Walter (Assoc. M. '46), (Concrete Product Co.), Dwight, Kans.

Williams, Donald Alfred (M. '46), Chf., Regional Water Conservation Div., Soil Conservation Service, Box 671 (Res., 5901 South West Brugger), Portland 1, Ore.

Wohlt, Paul Edward (Jun. '46), Engr., P-3 (Soil Mechanics), Soils and Materials Laboratory, Omaha Dist., U.S. Engr. Office, 2019 Farnam (Res., 6318 Blondo, Omaha 4), Nebr.

Woodworth, Robert Preston (Jun. '45), Ensign, U.S.N.R.; 74 Billings St., North Quincy, Mass.

Wright, Frank Walden (M. '46), Town Engr., Memorial Town Hall (Res., 4 Lansdowne Ave.), Hamden, Conn.

Yost, Harold Winans (M. Feb. 11, 1946), Yost and Gardner, Engrs., 511 Heard Bldg., Phoenix, Ariz.

MEMBERSHIP TRANSFERS

Brown, William Carlton (Assoc. M. '39; M. '46), Associate Engr., City of San Diego Water Dept., 268 Civic Center, San Diego 1, Calif.

Clark, John Alfred (Jun. '30; Assoc. M. '39; M. '46) Comdr., CEC, U.S.N.R., Quarters S-5, R.F.D. 2, Annapolis, Md.

Clarke, John Clinton (Jun. '37; Assoc. M. '46), Senior San. and Public Health Engr., State Dept. of Public Health, 519 Dexter Ave. (Res., 115 Audubon Rd.), Montgomery 6, Ala.

Clarke, Terrence Kennedy (Assoc. M. '30; M. '45), Cons. Engr., 1836 Euclid Ave., Cleveland, Ohio.

Clayton, Frederick William (Jun. '41; Assoc. M. '46), Cons. Engr., 301 Byington Bldg.; Reno, Nev.

Dubois, Paul Emile (Jun. '40; Assoc. M. '46), Design Engr., J. S. Waldrep, Cons. Engr., 901 Tradesmans Bldg. (Res., 1244 South West 27th St.), Oklahoma City 9, Okla.

Enderlin, Harold Cecil (Jun. '37; Assoc. M. '46), 440 Gonzalez Drive, San Francisco, Calif.

Haile, Elmer Rathbun, Jr. (Jun. '31; Assoc. M. '46), Asst. Highway Engr., U.S. Public Roads Administration, 1440 Columbia Pike (Res., 3107 South Hayes St.), Arlington, Va.

Halvorson, Sigurd (Jun. '40; Assoc. M. '46), Lt. (jg), CEC, U.S.N.R., Public Works Dept., USNABPD, San Bruno (Res., 1017 South East 21st Ave., Portland 15), Calif.

Heckman, Joe Rowe (Jun. '42; Assoc. M. '46), Liberty Center, Ind.

Holstein, Paul Wherritt, (Jun. '33; Assoc. M. '38; M. '46), Comdr., CEC, U.S.N.R.; Box 306-K, Route 8, Tacoma, Wash.

Kadri, Suad (Jun. '37; Assoc. M. '45), Civ. Engr. and Contr., No. 5/4 First Apt., Akay Sokak, Bakanliklar, Ankara, Turkey.

Kahl, William Roe (Jun. '37; Assoc. M. '46), Structural Field Engr., Portland Cement Assn., (Res., Box 72), Reisterstown, Md.

Kaltenbach, Albert Bossyns (Jun. '39; Assoc. M. '46), Asst. Engr., Metropolitan Dist. of Baltimore County, Towson (Res., 4122 Kathland Ave.), Baltimore 7, Md.

King, Richard (Jun. '38; Assoc. M. '46), Special Instr. in Civ. Eng., Civ. Eng. Dept., Univ. of Texas, University Station (Res., 1517 West 31st St., Austin), Tex.

Kleinschmidt, Robert Baumbartner (Jun. '31; Assoc. M. '46), Instr., Gen. Eng. Rutgers Univ. (Res., 7 Bartlett St.), New Brunswick N.J.

Lang, Thomas Arthur (Jun. '39; Assoc. M. '45), Asst. Chf., Designing Engr., State Rivers and Water Supply Comm., 110 Exhibition St., Melbourne, Victoria, Australia.

McFadden, Gayle (Assoc. M. '22; M. '46), Head Engr., Chf., Paving & Railroads Branch, Eng. Div., Office, Chf. of Engrs., U.S. Army, 21st St. and Virginia Ave., N.W., Washington 25, D.C. (Res., 2418 Cameron Mills Rd., Alexandria, Va.)

Maca, Leon Francis (Assoc. M. '39; M. '46), Engr. (Hydrologic), Reservoir, River and Hydropower Operations Section, Hydrology Div., Branch of Project Planning, Bureau of Reclamation, U.S. Dept. of the Interior (Res., 720 Magnolia St.), Denver 7, Colo.

Mendenhall, John Dale (Jun. '35; Assoc. M. '46), Engr., Holmes and Narver, 626 South Spring St. (Res., 4637 Paula St.), Los Angeles 32, Calif.

Miller, Robert Smith (Jun. '33; Assoc. M. '45), Asst. Engr., Bridges, Southern Ry. Co., 101 North Gay St., (Res., 3433 Shawnee Lane), Knoxville, 16, Tenn.

Nixon, Vaughn Dorman (Jun. '45; Assoc. M '46), Div. Engr., E. I. DuPont de Nemours & Co., Box 1432, Martinsville, Va.

Puterbaugh, Jack Dudley (Jun. '37; Assoc. M '46), Civ. Engr., Chas. H. Shook, Inc., 582 West 2nd St., Dayton, 1 (Res., 105 South Main St., Centerville), Ohio.

Rohlich, Gerard Addison (Jun. '34; Assoc. M. '45), Associate Prof., San. Eng., The Pennsylvania State College, State College, Pa.

Schapiro, Koppel (Assoc. M. '36; M. '46), Associate and Prin. Structural Engr., Erik Floor and Associates, 139 North Clark St. (Res., 1062 Bryn Mawr Ave.), Chicago, Ill.

Shaw, Rollin Howard (Jun. '39; Assoc. M. '45), Ensign, CEC, U.S.N.R.; Box 582, Meeker, Colo.

Sloan, Earle Stephen (Jun. '36; Assoc. M. '46), Structural Engr., Fabricated Steel Constr., Bethlehem Steel Co., Box 58, Watts Station, Los Angeles 2, Calif.

Steinborn, Sydney Oswald (Jun. '41; Assoc. M. '46), 118 Seventh Ave. South, Apt. 282, Seattle 4, Wash.

Stenberg, Jack Emory (Assoc. M. '40; M. '46), Lt. Col., Corps of Engrs., U.S. Army; Box 124, Laramie, Wyo.

Tatum, Fred Erwin (Jun. 33; Assoc. M. '46), Associate Engr., U.S. Engrs., 751 South Figueroa St., Los Angeles (Res., 919 North Ridgewood Pl., Hollywood 38), Calif.

Troxell, John Adron (Jun. '33; M. '46), Vice-Pres. and Asst. Gen. Mgr., Puget Sound Bridge & Dredging Co., 2929 Sixteenth Ave., S.W., Seattle 4, Wash.

Veatch, Fred Milton (Assoc. M. '30; M. '45), Dist. Engr., U.S. Geological Survey, 207 Federal Bldg., Tacoma 2, Wash.

REINSTATEMENTS

Blotcky, Donald Eugene, Jun., reinstated Jan. 1, 1946.

Brady, Virgil Rue, Assoc. M., reinstated Jan. 1, 1946.

Cahill, Ralph Hughes, M., reinstated Jan 1, 1946.

English, Henry William, M., reinstated Feb. 19, 1946.

Fillenwarth, Albert Leland, Jun., reinstated Feb. 18, 1946.

Hiller, Robert J., Assoc. M., reinstated Feb. 19, 1946.

Kent, Edmund Randolph, Assoc. M., reinstated Feb. 21, 1946.

Morton, William, Assoc. M., reinstated Jan. 1, 1946.

Rolfe, Robert Lawrence, Assoc. M., reinstated Jan. 1, 1946.

Ruddell, Ronald Holmes, Assoc. M., reinstated Feb. 18, 1946.

Simms, Alfred Aston, Assoc. M., reinstated Feb. 18, 1946.

Storrs, Dean Scott, Jun., reinstated Feb. 1, 1946.

Taylor, Henry William, M., reinstated Jan. 1, 1946.

Willson, George Harrison, Assoc. M., reinstated Jan. 1, 1946.

RESIGNATIONS

Coyle, David Cushman, M., resigned Dec. 31, 1945.

Change of Address

Please fill in and mail this form whenever you change your address

SECRETARY, ASCE, 33 W 39th St., New York 18, N. Y.

Please change my address to the following:

Name..

Your Title..

Firm Name..

Street Address..

City................................P.O. Zone No.......State..............

Home Address..

City..State..............................

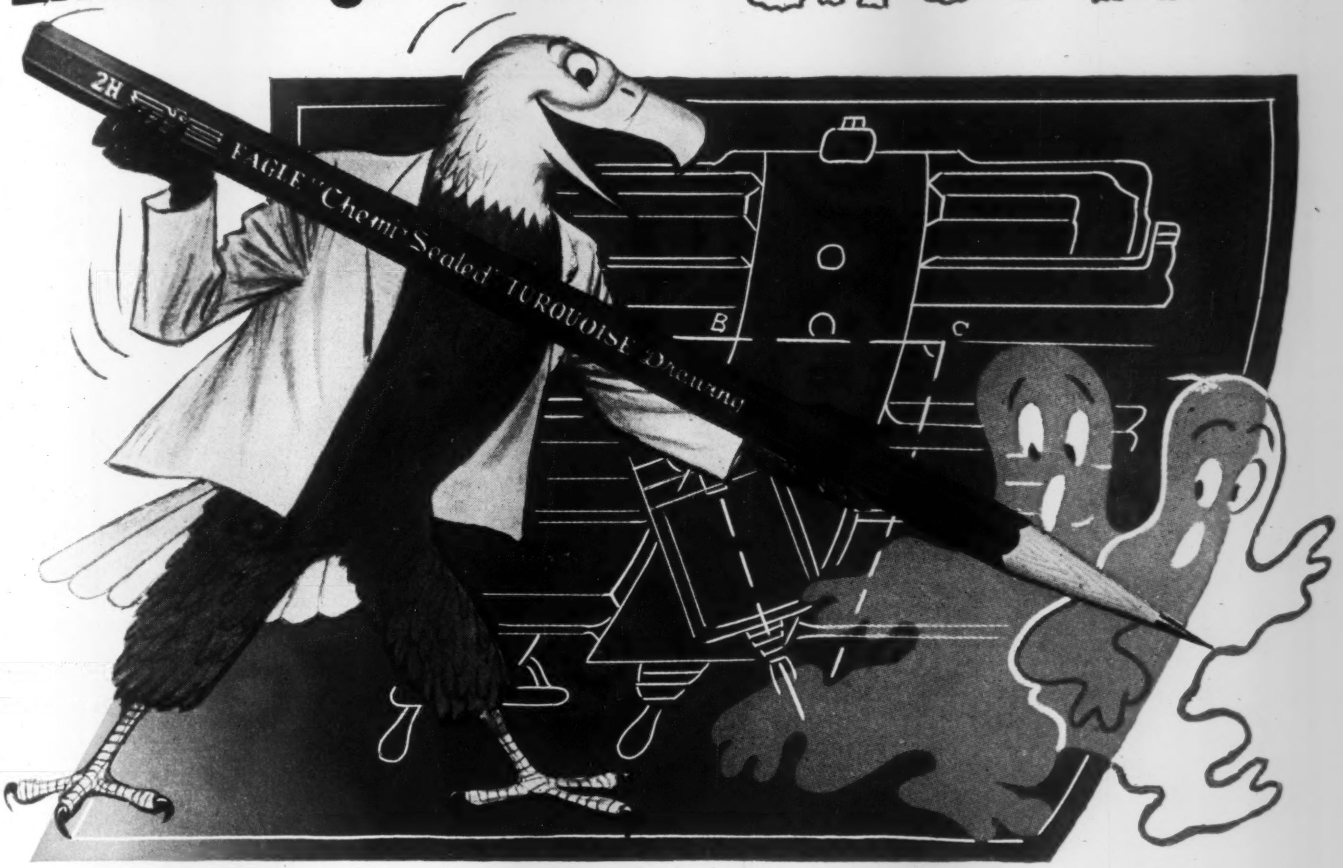
Nature af Business..

Mailing and Publications to ☐ Home ☐ Business

Listing in Yearbook to include:

☐ Home only ☐ Business only ☐ Home and Business

Ernest Eagle *chases* GHOSTS!



DEMONS of the drawing board, these two little wraiths haunted draftsmen's dreams . . . 'til TURQUOISE took over.

THE LITTLE LINE THAT *isn't* THERE

Somebody drew him, but he died. Burnt out in the intense glare of the printing machine, he became a pale shade of his former self . . . a here-again gone-again phantom that flits erratically across the prints. *But TURQUOISE lines stay put.* *Electronic graphite, super-refined in Eagle's patented Attrition Mill makes even the thinnest line so opaque and *solid* that it shows up . . . alive and hearty . . . on every print.

THE LITTLE LINE THAT *shouldn't* BE THERE

This is a stubborn little spirit. Drawn by mistake and erased, he hides in the pores of the paper and pops out to pester you in the prints. *But unwanted TURQUOISE lines can be "killed"* for keeps, because there is no penetrating chemical in TURQUOISE leads. All of the mark is on the surface of the sheet—a few strokes of an eraser remove it forever.

Write for a free TURQUOISE pencil or lead, naming this magazine, your dealer, and the grade you want.

10¢ *EACH*
less in quantities

EAGLE "CHEMI-SEALED"
(SUPER BONDED)
TURQUOISE
DRAWING PENCILS AND LEADS
EAGLE PENCIL COMPANY, 703 E. 13th St., New York 9, N. Y
Eagle Pencil Company of Canada, Ltd., Toronto

* Reg. U.S. Pat. Off.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

April 1, 1946 Number 4

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in Civil Engineering *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

Grade	General Requirement	Age	Length of Active Practice	Responsible Charge of Work
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i.e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

Abel, Stanford Edward (Assoc. M.), Washington, D.C. (Age 44) (Claims RCM 19.4) Oct. 1942 to Dec. 1945 Capt. and Major, Corps. of Engrs., U.S. Army; previously with Hechinger Eng. Corporation and Hechinger Property Co.

Babson, John Capron, Arlington, Va. (Age 43) (Claims RCA 8.0 RCM 11.4) July 1942 to date with Corps of Engrs., U.S. Army, being Major and Lt. Col.; previously Chf. of Mechanical Design Sec. and Asst. to Prin. Mech. Elec. Engr. for 3d Locks Design, Panama Canal.

Bedford, Thomas Archibald, Jr., Richmond, Calif. (Age 37) (Claims RCA 3.8 RCM 7.6) March 1942 to date with The Permanente Metals Corporation, since Aug. 1945 Vice-Pres. and Gen. Mgr. of The Permanente Metals Corporation, Kaiser Co., Inc., and Kaiser Cargo, Inc.; previously at Navy Yard, Mare Island, Calif.

Bobisch, William Julius (Junior), Omaha, Nebr. (Age 35) (Claims RCA 2.8 RCM 6.0) Dec. 1945 to date Senior Engr., U.S. Engr. Office, Omaha, Nebr.; previously Lt. (jg), Lt., and Lt. Commdr., CEC, U.S. Navy; Asst., Associate, and Engr., Special Eng. Div., Panama Canal.

Boschen, Henry Charles, Scarsdale, N.Y. (Age 39) (Claims RCA 5.0 RCM 9.0) July 1928 to date with Raymond Concrete Pile Co., New York City at present as Vice-Pres., since 1945 in New York Office in executive capacity.

Buckley, Jeremiah Paul, Sacramento, Calif. (Age 36) (Claims RCA 4.0 RCM 6.7) Feb. 1946 to date Senior Highway Engr., Joint Fact-Finding Comm. on Highways, Streets & Bridges California State Legislature, Sacramento, Calif.; previously with Transportation Corps, U.S. Army, finally as Major; with Michigan Highway Dept., Lansing, Mich.

Burdick, Roy Dayton, Little Rock, Ark. (Age 53) (Claims RCA 2.3 RCM 24.7) June 1916 to date with U.S Army, since July 1920 Capt., etc., to Col., Corps of Engrs.

Dalal, Chotalal Chunilal, Hyderabad-Deccan, India. (Age 52)(Claims RCA 12.0 RCM 17.3) Jan. 1915 to date with Public Works Dept. and H.E.H., The Nizam's Govt., in various capacities, from Feb. 1943 to July 1945 being Supt. Engr.; at present Consultant.

Dennis, Thomas Henry (Assoc. M.), Sacramento, Calif. (Age 61) (Claims RCA 11.2 RCM 19.6) March 1912 to date with California Div. of Highways, since Aug. 1926 as State Maintenance Engr.

Doll, Byron Emerson (Junior), Los Angeles, Calif. (Age 34) (Claims RCA 6.7 RCM 5.0) Dec. 1945 to date Deputy City Engr., Huntington Park, Calif.; previously with U.S. War Dept., Washington, D.C.; with Union Pacific R.R., Los Angeles, Calif.

Gwathmey, Cabell, Charlottesville, Va. (Age 43) (Claims RCA 4.6 RCM 5.7) Jan. 1942 to date with U.S. Army, finally as Lt. Col., at present hospitalized; previously with U.S. Dist. Engr., California, Florida, and Washington, D.C.

Hanson, Terence Charles St. Alwyn (Assoc. M.), Pernambuco, Brazil. (Age 43) (Claims RCA 12.4 RCM 9.0) Feb. 1927 to date with Great Western of Brazil Ry., since Sept. 1943 as Asst. Chf. Engr.

Harper, Harold Francis, Salina, Kans. (Age 37) (Claims RCA 0.7 RCM 10.7) Jan. 1946 to date City Engr., Salina, Kans.; previously with San. Corps, U.S. Army; City Engr., Manhattan, Kans.

Jorgensen, Roy Ernst, Glastonbury, Conn. (Age 37) (Claims RCA 3.0 RCM 8.2) Oct. 1942 to date Director of Highway Planning, Connecticut Highway Dept.; previously with U.S. PRA.

Lauenstein, Carl Albert (Assoc. M.), San Francisco, Calif. (Age 44) (Claims RCA 12.2 RCM 6.8) March 1930 to date with San Francisco Water Dept., since July 1945 as Civ. Engr.

Leshan, Abraham, New York City. (Age 43) (Claims RCA 3.2 RCM 11.2) Jan. 1939 to date Civil Engr., New York City Planning Comm.

McQueen, Howard Renton, San Diego, Calif. (Age 60) (Claims RCA 5.1 RCM 24.3) Nov. 1939 to date with Canadian Army, Dist. Ordnance Mech. Engr., M.D. 4, M.D. 7, Inspector, Elect. & Mech. Services, Major RCEME; previously Pres. and Gen. Mgr., Iron Fireman Ltd., Montreal.

Mehandru, Tirath Ram, Lahore, India. (Age 39) (Claims RCA 3.6 RCM 11.3) Sept. 1932 to date in private practice as Archt. and Civ. Engr., designing supervising construction of works for Univ. of Punjab, etc.

Riedel, Charles Allen, Brooklyn, N.Y. (Age 44) (Claims RCA 5.5 RCM 14.2) Nov. 1940 to Nov. 1941 and Jan. 1942 to Aug. 1945 with U.S. Army, being Capt. and Major; previously and at present Civ. Engr., Board of Estimate, New York City.

Robinson, John Edward (Assoc. M.), Brooklyn, N.Y. (Age 44) (Claims RCA 4.3 RCM 13.2) Aug. 1918 to date with American Bridge Co., since March 1931 as Designer, New York City.

Sawyer, Robert William, 3d (Assoc. M.), New York City. (Age 39) (Claims RCA 4.6 RCM 10.0) Aug. 1931 to date with Malcolm Pirnie, New York City, since Nov. 1934 as Associate Engr.

Seeland, Elias, New York City. (Age 39) (Claims RCM 18.1) Nov. 1940 to date with U.S. Army, since Jan. 1944 Chf. Engr., Office of Chf. Engr., London, England; later with U.S. Group Control Council, Germany (Frankfort and Berlin).

Seeman, Lyle Edward (Assoc. M.), Santa Fe, N.Mex. (Age 39) (Claims RCA 7.6 RCM 5.2) Sept. 1928 to date with Corps of Engrs., U.S. Army, at present as Col., since June 1945 Senior Mil. Officer, with Santa Fe detachment, Manhattan Engr. Dist.

Simmons, Lansing Grow, Arlington, Va. (Age 44) (Claims RC 19.3 D 6.9) July 1931 to date with U.S. Coast & Geodetic Survey, since July 1943 at Washington (D.C.) Office, Consultant on State Plane Coordinate Systems, etc.

Sindt, Waldemar Henry, Ft. Worth, Tex. (Age 47) (Claims RCA 3.1 RCM 11.7) Dec. 1942 to date with FWA, as Special Representative of Regional Director, Asst. Regional Engr., Asst. Div. Engr., and since Jan. 1946 Div. Engr., Bureau of Community Facilities; previously with Oklahoma WPA finally as State Director; Eng. and Constr. Div.

Smith, Gerald Wood, Kirkwood, Mo. (Age 44) (Claims RCA 7.9 RCM 7.1) May 1932 to Oct. 1942 Asst. Engr., and Jan. 1946 to date Constr. Engr., Sverdrup & Parcel, St. Louis, Mo.; in the interim with USNR.

Sporseen, Stanley Emanuel (Assoc. M.), Portland, Ore. (Age 40) (Claims RCA 3.0 RCM 5.5) Aug. 1934 to date with U.S. Army Engrs., being Jun. Engr., Asst. Engr., Associate Engr., Engr., and since June 1945 with Planning and Layout Sec., as Asst. to Sec. Head; since Oct. 1943 also member of firm, Sporseen & Associate, Engrs.

Stueber, Gustav (Assoc. M.), Pittsburgh, Pa. (Age 36) (Claims RCA 2.1 RCM 6.5) Sept. 1945 to date Structural Engr. and Squad Leader, Dravo Corporation, Pittsburgh; previously 1st Asst. Engr. (Bridge Engr.), Pittsburgh & West Virginia R.R. Co., Pittsburgh, Pa.; Process Engr., Budd Mfg. Co. of Philadelphia; Designing Engr. and Squad Leader, United Engrs. & Constrs., Inc., Philadelphia, Pa.; with Pittsburgh-Des Moines Steel Co., Des Moines, Iowa.

Toler, George Gatlin (Assoc. M.), Ada, Okla. (Age 45) (Claims RCA 11.1 RCM 10.0) Sept. 1931 to date Cons. Engr., Ada, Okla.

Wallace, Donald Sanford (Assoc. M.), Charlottesville, Va. (Age 46) (Claims RCA 4.3 RCM 15.6) Feb. 1922 to date with U.S. Geological Survey, since Dec. 1945 as Hydr. Engr., P-6.

Watson, John Dargan (Assoc. M.) Greensboro, N.C. (Age 40) (Claims RCA 4.8 RCM 5.3) Dec. 1945 to date Cons. Engr., Greensboro, N.C.; previously Chf. Engr. for J. A. Jones Constr. Co., Charlotte, N.C.; Consultant to Norfolk Dist. Corps of Engr., U. S. Army; Asst. Prof. of Civ. Eng., Duke Univ.; Asst. Prof., Harvard Univ.

Wegman, Leonard Samuel (Junior), New York City. (Age 35) (Claims RCA 3.2 RCM 5.6) Oct. 1944 to date Cons. Civ. Engr., being Senior Partner, Leonard S. Wegman & Co., New York City; previously with U.S. Engr. Office, New York Dist. Engrs.; Asst. Res. Engr. with Borough Pres. of Manhattan.

White, Sargent (Assoc. M.), Falls Church, Va. (Age 38) (Claims RCA 3.3 RCM 9.6) Feb. 1942 to date Engr., RFC, Washington, D.C.; previously Asst. Airways Engr., CAA, Washington, D.C.; Constr. Engr., O. L. Murdock, Maryland and Virginia.

Wierschem, Henry Frank, Milwaukee, Wis. (Age 46)(Claims RCA 6.0 RCM 12.0) 1918 to date with Lakeside Bridge & Steel Co., Milwaukee, Wis., since 1936 as Chf. Structural Engr.

APPLYING FOR ASSOCIATE MEMBER

Anderson, Barroll Edward, Tooele, Utah. (Age 47) (Claims RCM 9.1) 1941 to date with U.S. Army, at present as Lt. Col., being Liaison Engr., Post Engr., etc.; previously Senior Associate and Mgr., John F. Covert Co.

Now that Johnny is coming home....

GIVE HIM PLENTY OF BIG JOBS TO DO

RIGHT NOW, on the home front, it's up to city officials and leading engineers to do their part in planning new municipal water mains and other public works projects. It's one way to have steady employment ready for local men when their present job is finished.

By specifying Lock Joint Reinforced Concrete Pressure Pipe for water supply lines, sewerage and drainage, you can fulfill your promise to your own returning men. For, the Lock Joint Pipe Company is prepared to come to your town, set up a temporary plant and employ 90% of local labor. As most of the supplies and materials will be purchased locally, there will be a direct benefit to your town merchants. As a result, a large proportion of the cost of the project will be spent right in your own community.

For more than four decades Lock Joint Pipe has played a vital part in the majority of large diameter water pipe contracts in the United States. Now that Victory has come, we are ready to help you give your engineers, mechanics, carpenters, laborers and other skilled workers the jobs they need.

Whether your project is large or small, for the present or the future, your 'phone call, telegram, cable or letter to any of our offices will bring a prompt reply.

LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

LOCK JOINT PIPE COMPANY
Established 1905
P. O. BOX 269, EAST ORANGE, N. J.
Denver, Colo. • Chicago, Ill. • Kenilworth, N. J. • Kansas City, Mo. • Rock Island, Ill.
Joplin, Mo. • Valley Park, Mo. • Cleveland, Ohio • Hartford, Conn. • Navarre, Ohio

SCOPE OF SERVICES *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*

BABCOCK, WILLARD FARRINGTON (Junior), Raleigh, N.C. (Age 29) (Claims RCA 3.5) 1940 to date with Civ. Eng. Dept., North Carolina State Coll., since 1942 as Asst. Prof.

BALDWIN, WILLARD JUSTUS (Junior), Atlanta, Ga. (Age 34) (Claims RCA 4.3) Nov. 1941 to date Senior Engr., South Atlantic Div. Office, U.S. Engr. Corps, being Head, Structural Sec.; previously Chf. Eng. Draftsman, Design Sec., Planning Div., Brooklyn (N.Y.) Navy Yard.

BEAM, CHARLES HOWARD, Pittsburgh, Pa. (Age 36) (Claims RCA 7.8 RCM 3.2) March 1934 to Sept. 1942 Draftsman, Surveyor and Design Engr., and Jan. 1946 to date Design Engr., Gulf Research & Development Co., Pittsburgh; previously with Army Air Forces finally as Major.

BENKE, SYLVESTER HERMAN, Cleveland, Ohio. (Age 42) (Claims RCA 13.7) Aug. 1944 to date Estimating Engr., Cleveland (Ohio) Elec. Illuminating Co.; previously Party Chf., Fraser-Brace Eng. Co., Keystone Ordnance Works, Geneva, Pa.; Project Engr., and Project Supervisor, WPA, in Cuyahoga (Ohio) Dist. Office, Operations Div.

BUIE, TRACY AUGUSTUS, Baton Rouge, La. (Age 45) (Claims RCA 12.0 RCM 5.1) 1922 to date with Louisiana Highway Comm., since 1941 as Head Bridge Draftsman, Bridge Design Sec.

CONARD, RAYMOND FOSS (Junior), College Park, Md. (Age 34) (Claims RCA 3.2 RCM 4.3) April 1941 to date Engr. Unit Comdr., Corps of Engrs., U.S. Army; previously Hydrographer, U.S. Geological Survey; Student Highway Engr., U.S. Bureau of Public Roads.

CORNELL, RUSSEL MARBLE (Junior) Minneapolis, Minn. (Age 34) (Claims RCA 1.0) July 1941 to date with Univ. of Minnesota, since 1945 as Asst. Prof. Civ. Eng.; previously Instructor in Civ. Eng., Columbia Univ., New York City.

EDELSTEIN, HARRY ALLEN, Brooklyn, N.Y. (Age 36) (Claims RCA 3.5) June 1942 to Jan. 1946 Lt. (jg), Lieut., and Lieut. Commdr., U.S. Navy; previously with Dept. of Parks, New York City, being Chf. of Party, Eng. Asst., and Res. Engr.

ELMQUIST, FRANS GUNNAR, Chicago, Ill. (Age 46) (Claims RCA 7.1) June 1929 to date with Chicago, Milwaukee, St. Paul & Pacific R.R., Chicago, Ill., in various capacities, since March 1945 being Asst. Engr.

FLANDERS, ROYAL CALL (Junior), Lincoln, Mass. (Age 35) (Claims RCM 4.4) July 1940 to date with Stone & Webster Eng. Corporation, Boston, Mass., being Draftsman, Designer, and Squad Chf.; previously with Nepesco Services, Inc., Augusta, Me.

FULLER, JOHN DRAYTON, Knoxville, Tenn. (Age 41) (Claims RCA 5.3 RCM 1.0) Sept. 1944 to date Design Engr., Knoxville (Tenn.) Eng. Dept.; previously with TVA.

GILMAN, ROGER HOWE (Junior), New York City. (Age 31) (Claims RCA 6.7) May 1937 to Feb. 1942 and Nov. 1945 to date with The Port of New York Authority, since Nov. 1945 Asst. to Director of Port Development; in the interim Ensign to Lieut., U.S. Navy.

GOLD, MICHAEL, Chelsea, Mass. (Age 31) (Claims RCA 5.7 RCM 1.5) Jan. 1944 to date Asst. Engr. (R), U.S. Public Health Service; previously instrumentman, Massachusetts Highway Dept.; Structural Draftsman and Structural Steel Designer, Stone & Webster Eng. Corporation.

GOLLY, MILLIS RAY (Junior), Springfield, Ill. (Age 35) (Claims RCA 3.7) March 1942 to Nov. 1945 1st Lieut. and Capt., Field Artillery, U.S. Army; previously and at present with Illinois Dept. of Public Health, Div. of San Eng., Springfield, Ill., being Dist. Engr. and Asst. Engr.

HAGAR, CALLAWAY, Lawrence, Kans. (Age 42) (Claims RCA 5.8 RCM 2.6) Jan. 1945 to date Supt., Water Dept., Lawrence, Kans.; previously with Malaria Div., U.S. Public Health Service, under Missouri State Board of Health; Chf. Engr. and later Mgr., Ashley Div., General Aviation Equipment Co., Wilkes-Barre, Pa.; Supt., Water Dept., Boonville, Mo.

HELGESSON, AXEL LESLIE, Indianapolis, Ind. (Age 41) (Claims RCA 8.9) Feb. 1935 to date with Indiana Highway Comm., in various capacities, since Sept. 1945 being Asst. Engr. of Bridge Design.

HOLMES, ROBERT STRATTON (Junior), Washington, D.C. (Age 33) (Claims RCA 4.5) May 1941 to date with U.S. Army, at present as Major, being Chf., Motor Vehicle Safety Sec., Safety Branch, Provost Marshal General's Office, War Dept., Washington, D.C.; previously with National Conservation Bureau, New York City.

HOOD, JAMES EDWARD (Junior), Norfolk, Va. (Age 35) (Claims RCA 6.5 RCM 2.4) Feb. to Aug. 1943 and Dec. 1945 to date Gen. Supt., Boney Constr. Co.; in the interim with Corps of Engrs., U.S. Army, as 1st Lt., Capt., and Major; previously Engr., Tidewater Constr. Corporation; Engr., C. A. Didden Co.

JAMES, CLYDE NOBLE, JR. (Junior) Lubbock, Texas (Age 32) (Claims RCA 10.2) Feb. 1944 to date Engr.-Partner, Lubbock (Tex.) Eng. Co.; previously with U.S. Engrs., South Plains AAF Lubbock, finally as Assoc. Engr.; Res. Engr. French & Pruit Co.

JOHNSON, STANLEY LATHROP, Hastings-on-Hudson, N.Y. (Age 36) (Claims RCA 3.5) Nov. 1945 to date Chf. of Survey Party, Parsons, Brinckerhoff, Hogan & MacDonald, New York City; previously Major, U.S. AAF, CBI Service Command; Shaft Engr., Pleasantville Constrs., Inc. (Spencer, White & Prentis, New York City).

KENDRICK, JOHN STAFFORD, Victoria, BC., Canada (Age 28) (Claims RCA 1.4) June 1938 to March 1942 and Aug. 1945 to date with Water Rights Branch, Govt. of British Columbia, finally as Dist. Engr.; in the interim with Royal Canadian Navy.

LONG, JOHN FREDERICK (Junior), Hannibal, Mo. (Age 35) (Claims RCA 6.2) July 1943 to Jan. 1946 with U.S. Army overseas; previously with U.S. Engr. Dept., finally as Asst. Engr. (Civ.).

LUSTBADER, EDWARD EMANUEL (Junior), Brooklyn, N.Y. (Age 27) (Claims RCA 4.0 RCM 1.8) Feb. 1942 to date Engr., Atlas Architectural Constr. Co., Inc., New York City; previously with Psaty & Fuhrman, Inc., New York City, as Asst. Supt., Estimator and Expeditor.

MANN, RICHARD LESLIE, Washington, D.C. (Age 33) (Claims RCA 4.3) June 1939 to date with CEC, USNR, being Lieut. (jg), Lieut., Lieut. Comdr., and Comdr., since Dec. 1945 on staff of Army Navy Explosives Safety Board, Washington, D.C.

MILLER, ROBERT BOYD (Junior), Chehalis, Wash. (Age 35) (Claims RCA 9.0) Dec. 1945 to date Asst. Agri. Engr. P-2, SCS; previously Ensign, Lieut. (jg), and Lieut., USNR; with SCS, USDA.

MOATS, HAROLD LEE, Seattle, Wash. (Age 37) (Claims RCA 7.6) March 1934 to date with U.S. Engr. Office, since June 1944 being Engr. and Senior Engr., Hq., Alaskan Dept., Office of Engr.

MORGAN, RUSSELL, Mt. Vernon, Ohio. (Age 40) (Claims RCA 4.1 RCM 5.5) Dec. 1945 to date Senior Engr. with Div. Engr., U.S. Div. Engr. Office, Columbus, Ohio; previously with Bureau of Yards & Docks, U.S. Navy, Washington, D.C.; Associate Engr. and Engr., with Div. Engr., U.S. Div. Engr. Office, Cincinnati, Ohio.

MORRIS, IRVIN DANIEL (Junior), Colville, Wash. (Age 35) (Claims RCA 1.5) Feb. 1943 to date with CEC, USNR, being Ensign, Lt. (jg), and since Nov. 1945 Lt.; since Oct. 1945 serving as Operations Officer; previously Engr., Davis Dam Bldrs., Kingman, Ariz.; Cost Engr., Contrs., Pacific Naval Air Bases; Jun. Engr., Bureau of Reclamation, Denver.

MURPHY, JAMES PATRICK, Springfield, Ill. (Age 31) (Claims RCA 3.1 RCM 4.8) Jan. 1946 to date member of firm, Crawford, Murphy & Tilly, Cons. Engrs., Springfield, Ill.; previously Highway Traffic Engr., War Dept., ETO; Senior Asst., Traffic Engr., Traffic Eng. Bureau, Detroit, Mich.; Jun. Engr. to Associate Engr., U.S. Engr. Corps, Detroit, Mich., and Massena, N.Y.

NATALI, DANTE, San Francisco, Calif. (Age 51) (Claims RCA 4.1) July 1943 to date Associate Civ. Engr. P-3 Structural, Alameda (Calif.) Naval Air Station, Public Works Dept.; previously with U.S. Engrs., being Chf. Eng. Draftsman (Civil), and Asst. Civ. Engr. P-2; in private practice as Architectural Designer, San Francisco, Calif.

NELSON, GEORGE ALBERT, (Assoc. M.), Carderock, Md. (Elected Oct. 14, 1935) (Age 33) (Claims RCA 8.1) March 1941 to date with U.S. Navy, being Lt. (jg), Lt., Lt. Comdr., and since Feb. 1946 Comdr., being Public Works Officer, David W. Taylor Model Basin, Carderock, Md.; previously Asst. Hydr Engr., The Panama Canal, Special Eng. Div., Balboa, C.Z.

OCVIRK, FRED WILLIAM (Junior), Ithaca, N.Y. (Age 32) (Claims RCA 3.3) Dec. 1940 to Dec. 1944 and Nov. 1945 to date with Cornell Univ., since Dec. 1942 as Asst. Prof. of Aeronautical Eng.; in the interim with Johns-Hopkins Applied Physics Laboratory, Silver Spring, Md.

OLTMAN, ROY EDWIN, Minneapolis, Minn. (Age 34) (Claims RCA 5.5 RCM 0.9) June 1938 to Feb. 1943 and Jan. 1946 to date with U.S. Geological Survey, as Jun. Asst. and Associate Hydr. Engr., Water Resources Branch, St. Paul, Minn., and Washington, D.C., in the interim Ensign, Lt. (jg.), and Lt., U.S.N.R.

ORD, MELVIN JAMES (Junior), Alhambra, Calif. (Age 34) (Claims RCA 3.0 RCM 2.8) Sept. 1937 to date with U.S. Engr. Office, Los Angeles, Calif., finally as Engr., being Head of hydrology subsection.

PETRY, NICHOLAS ROBERT, Denver, Colo. (Age 27) (Claims RCA 7.6) March 1943 to date with CEC, Bureau of Yards & Docks, U.S. Navy, since Nov. 1945 as Asst. Civ. Works Engr. and Officer-in-Chg. of Constr.; previously member of firm, N. G. Petry, Gen. Contrs., Denver; Gen. Supt., Petry-Cook, Contrs.; with N. G. Petry Co., Denver, Colo.

RACKLE, GEORGE PAXTON, Cleveland Heights, Ohio. (Age 33) (Claims RCM 6.1) March 1937 to Sept. 1943 and Jan. 1946 to date with Geo. Rackle & Sons Co., Cleveland, being Draftsman, Designer, Shop Supt., and First Vice-Pres.; in the interim Lt., U.S. Coast Guard, Civ. Eng. Dept., Washington, D.C.

RATCHYE, JOHN FREDERICK, Helena, Mont. (Age 39) (Claims RCA 6.9 RCM 5.9) 1926 to 1941, 1942, and 1945 to date with Montana Highway Dept., in various capacities, since 1945 as Office Engr.; in the interim Lt. and Capt., Corps of Engrs., U.S. Army; Constr. Engr. WPA and CAA.

REILLY, ROBERT BONAPARTE, Dallas, Tex. (Age 41) (Claims RCA 7.9 RCM 1.0) March 1945 to date Design Engr., Powell & Powell, Engrs., Dallas, Tex.; previously Supt., Austin Road Co., Dallas.

RIPPSTEIN, RAYMOND CHARLES, San Antonio, Tex. (Age 36) (Claims RCA 4.8 RCM 6.6) July 1941 to date with Corps of Engrs., U.S. Army being Major and (since Nov. 1943) Lt. Col.; previously Asst. Engr., J. W. Beretta Engrs., Inc., National Bank of Commerce Bldg., San Antonio, Tex.

ROBBINS, EDWIN GUY (Junior) Chicago, Ill. (Age 30) (Claims RCA 6.1 RCM 0.4) April 1943 to date with U.S. Navy, finally as Utilities Supt. Public Works Dept., U.S. Naval Adv. Base Depot, Port Hueneme, Calif.; previously Soil-Cement Research Engr., Portland Cement Association, Chicago, Ill.

SCHEINMAN, MORRIS, Brooklyn, N.Y. (Age 33) (Claims RCA 7.2) Jan. 1946 to date with office of Henry W. Taylor, Cons. Engr.; previously with Design Sec. (Hull), Navy Yard, New York, being Jun. Naval Archt., Asst. Naval Archt., and Associate Naval Archt.

SCHOLES, THOMAS FRANCIS (Junior), Ft. Wyne, Ind. (Age 31) (Claims RCA 5.0 RCM 3.8) June 1936 to date with Pennsylvania R.R., since April 1942 as Supervisor of Track Main Line.

SCHWAB, FREDERIC ANTHONY, Kansas City, Mo. (Age 34) (Claims RCA 5.1) Nov. 1937 to date with U.S. Engrs. in various capacities, since Dec. 1943 as Asst. Engr.

SITLER, WILLARD STANLEY (Junior), Millersburg, Pa. (Age 30) (Claims RCA 4.1 RCM 2.0) Sept. 1940 to Jan. 1946 with U.S. Army Engrs., at present Major, being Chf. of Sec. of Air Installations Div. of Hqs. AAF; at present on terminal leave.

SKOW, FLOYD ARTHUR, Ames, Iowa. (Age 35) (Claims RCA 2.4) Jan. 1941 to date with U.S. Army, being 1st Lt., Capt., Major, Lt. Col., and since Oct. 1945 Col. (on terminal leave); previously Agr. Engr. P-1, U.S. Erosion Service (SCS).

SMELSER, PAUL EDWARD (Junior), Mobile, Ala. (Age 34) (Claims RCA 4.9) June 1942 to date with Corps of Engrs., U.S. Army, being 1st Lt. and Capt.; previously with U.S. Engrs., finally as Prin. Eng. Aide.

SMITH, JAMES HENRY, Denver, Colo. (Age 42) (Claims RCA 4.4 RCM 3.8) Nov. 1928 to date with U.S. Bureau of Public Roads, Since Jan. 1943 as Highway Engr.

SOUTHERLAND, HENRY DELEON, JR. (Junior), APO San Francisco, Calif. (Age 34) (Claims RCA 5.8 RCM 2.8) May 1942 to date with U.S. Army finally as Lieut. Col., being Chief of Requirements Sec., Ord. Dept.; previously Jun. and Asst. Engr., TVA.

SPAEDER, HAROLD JOHN, Chicago, Ill. (Age 37) (Claims RCA 6.5) Nov. 1944 to date Sales Engr., San Eng. Div., The Dorr Co., Chicago, Ill.; previously Capt. and Major, Anti-Aircraft Artillery, CAC; Dist. San. Eng., Illinois Dept of Public Health, Dist. 14.

STAATS, HENRY RYAN, Portland, Ore. (Age 40) (Claims RCA 7.0 RCM 5.4) June 1936 to Jan. 1937, Oct. 1938 to Nov. 1942, and Jan. 1946 to date with U.S. Engrs., since Jan. 1946 as Head of Surveys, Portland Dist.; in the interim Capt. Corps of Engrs., U.S. Army; Asst. of Chf. Location Engr., Oregon Highway Comm.

STEWART, JOHN ROBERTSON (Junior), Johannesburg, South Africa. (Age 35) (Claims RCA 6.3 RCM 1.4) Aug. 1945 to date Eng. Asst., Stewart, Shand & Oliver, Cons. Engrs., Johannesburg; previously with Engr. Corps, South African Army, being Lieut., Capt., and Major.

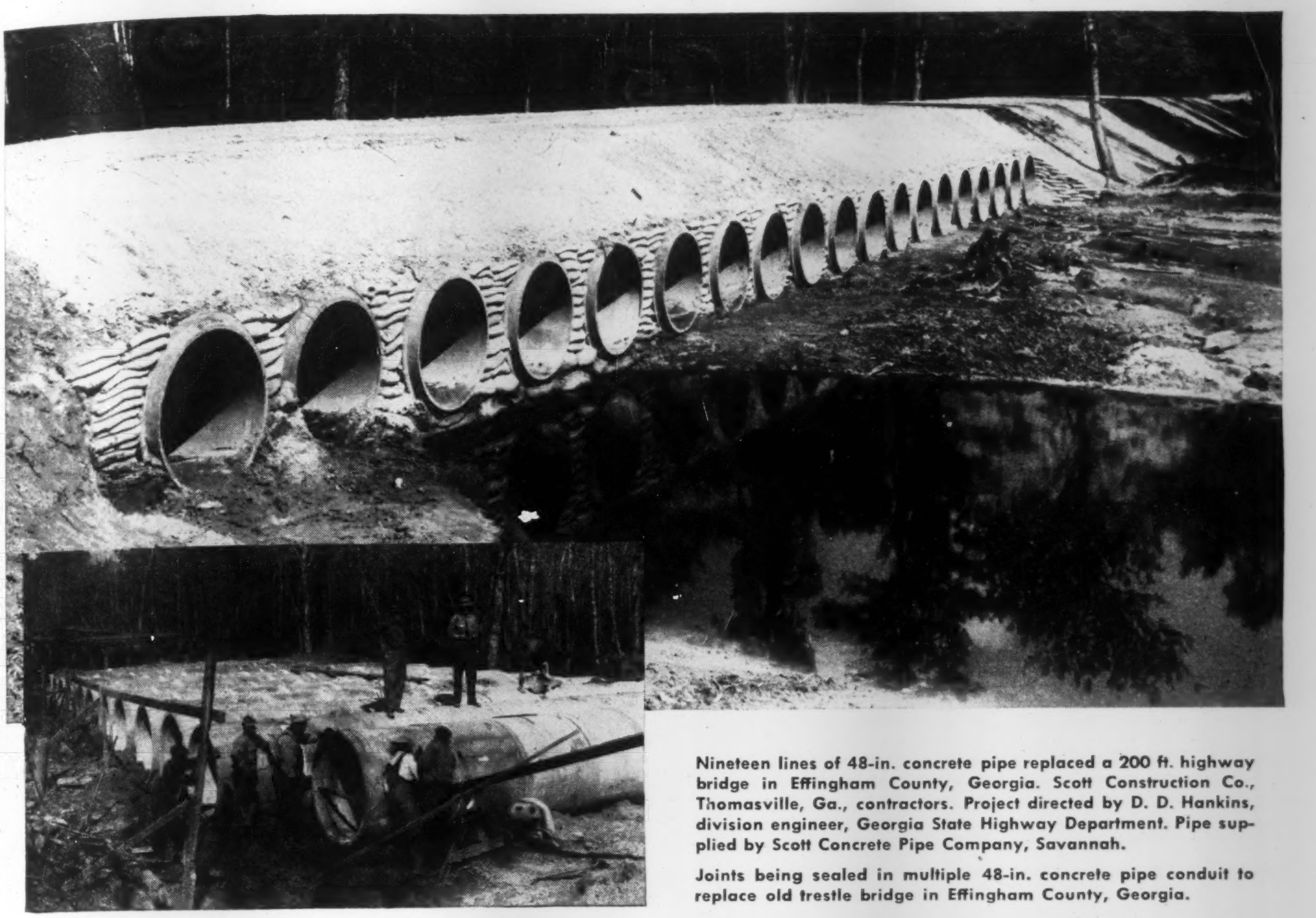
STOKES, HERBERT RAYMOND (Junior), Birmingham, Ala. (Age 34) (Claims RCA 6.9 RCM 1.5) June 1941 to date with Corps. of Engrs., U.S. Army, retired as Lt. Col.; previously with TVA.

STRIEKERT, ROY ROBERT, Houston, Tex. (Age 45) (Claims RCA 2.2) April 1929 to date with Gulf Oil Corporation, Houston, Tex., since Feb. 1945 as Chf. Draftsman, Civ. Eng. Dept.

THOMAS, HENRY HARDSTAFF (Junior), Tasmania, Australia. (Age 34) (Claims RCA 7.1) Sept. 1938 to date Senior Asst. Engr., Hydro-Elec. Comm., Hobart, Tasmania.

THRAPP, HARRISON FRANCIS (Junior), Chicago, Ill. (Age 36) (Claims RCA 4.1 RCM 4.5) June 1940 to date with CEC, USNR, finally as Comdr. previously Design Engr., Standard Oil Co., Whiting, Indiana.

TORRENCE, CARL LINDEN (Junior), Richmond, Va. (Age 34) (Claims RCA 6.7) Nov. 1945 to date Engr., Real Estate & Eng. Services, Southern



Nineteen lines of 48-in. concrete pipe replaced a 200 ft. highway bridge in Effingham County, Georgia. Scott Construction Co., Thomasville, Ga., contractors. Project directed by D. D. Hankins, division engineer, Georgia State Highway Department. Pipe supplied by Scott Concrete Pipe Company, Savannah.

Joints being sealed in multiple 48-in. concrete pipe conduit to replace old trestle bridge in Effingham County, Georgia.

CONCRETE PIPE CULVERTS

Effect substantial economy in replacement of bridges

INSTALLATIONS of multiple concrete pipe conduits have demonstrated substantial economies in replacement of worn out highway bridges.

Concrete pipe culverts serve equally well under deep or shallow fills because they have ample strength for the most severe load or impact.

Concrete pipe culverts are a good investment for these additional reasons:

Maximum hydraulic capacity assured by smooth interior surface.

Simplicity of installation means moderate first cost.

Durability has been proved by many years of service on thousands of miles of state and county highways.

Write this Association or any of its members for informative literature on uses of concrete pipe for airport, highway or land drainage systems or culverts. List of our members furnished on request.

AMERICAN CONCRETE PIPE ASSOCIATION

228 North La Salle Street • Chicago 1, Illinois

States Cooperative, Inc., Richmond; previously Draftsman and Structural Designer, Richmond, Fredericksburg & Potomac R.R., Richmond; with Cruickshank's Iron Works, Richmond.

VILJOEN, GIDEON PETRUS, Union of South Africa. (Age 41) (Claims RCA 3.8 RCM 7.1) Nov. 1944 to date Town Engr., Volksrust, Transvaal ; previously Town Engr., Beaufort West Municipality, being Design and Constr. Engr.

VON SEGGERN, MARVIN EMIL, Mobile, Ala. (Age 35) (Claims RCA 3.6 RCM 1.0) Jan. 1942 to date Associate Engr., U.S. Engr. Office, Flood Control Sec.; previously Asst. Engr., Office of QM. Gen.; Jun. Hydr. Engr., U.S. Forest Service, Denver, Colo.

WAH HING, N.G. Cambridge, England. (Age 29) (Claims RCA 1.6) Jan. 1945 to date Research Student, Univ. of Cambridge, England; previously Asst. Engr., Sir Robert McAlpine & Sons, Ltd., London, England; Asst. Engr., The Motherwell (Scotland) Bridge & Eng. Co., Ltd.

WANEE, LESSLEY DEAN, San Bernardino, Calif. (Age 39) (Claims RCA 4.7) May 1929 to date with California Div. of Highways, at present as Associate Highway Engr., since Sept. 1944 Dist. VIII Hydraulic Engr.

WEED, SAM ALLEN, San Antonia, Tex. (Age 41) (Claims RCA 9.0) Dec. 1944 to date Capt., San. Corps, U.S. Army; previously San. Engr., Service Command Engrs. Office, Hq. 9th Service Command, Fort Douglas, Utah; San Engr. San. Eng. Dept., Golden Gate International Exposition; with Eng. Dept., City of Oakland, Calif.

WELCH, CLARENCE BENNING (Junior), Pottstown, Pa. (Age 30) (Claims RCA 0.7 RCM 1.7) June 1941 to Jan. 1946 with Corps. of Engrs., U.S. Army, being Engr. Staff Officer, Executive Officer, Commanding Officer, since April 1945 Lt. Col.; previously and at present with Bethlehem Steel Co.

WHITE, ROSSITER LAWRENCE (Junior), Los Angeles Calif. (Age 29) (Claims RCA 4.7) June 1940 to, date with USED, Los Angeles, Calif., since Jan. 1946 as Engr. (Structural) (P-3).

WOODWARD, DOUGLAS RUSSELL (Junior), Salt Lake City, Utah. (Age 34) (Claims RCA 2.8) May to Oct. 1935, Nov. 1936 to May 1942 and Jan. 1946 to date with U.S. Geological Survey, since Jan. 1946 as Asst. Engr. P-2, Water Resources Branch; in the interim Lt., Capt., and Major, U.S. Army; San. Engr., State Dept. of Health, New Hampshire.

APPLYING FOR AFFILIATE

WILSON, CHARLES RUDD, Beaverton, Ore. (Age 48) (Claims RCA 7.2 RCM 5.0) Jan. 1942 to date Sales Mgr. and Field Supervisor; previously Sales Engr., Gorman Lumber Sales Co.

APPLYING FOR JUNIOR

FOSTER, ROLLIN BANISTER, Bethlehem, Pa. (Age 29) (Claims RCA 1.0) Aug. 1941 to date with Bethlehem (Pa.) Steel Co., since March 1944 as Jun. Designer.

JACOBS, MILLARD WOLFORD, Sierra Madre, Calif. (Age 27) (Claims RCA 4.5) Oct. 1945 to date Structural Engr., Latisteel, Inc., Pasadena, Calif.; previously with Lockheed Aircraft, Burbank, Calif., finally as Senior Stress Analyst.

NESBIT, HARRISON SCOTT, Richmond, Va. (Age 26) Dec. 1945 to date Engr., Grade 6, Virginia Dept. of Highways; previously with Corps. of Engrs., U.S. Army, finally as Lt. Col.

OLIVERO, HUMBERTO, JR., Guatemala, Guatemala. (Age 27) (Claims RCA 1.7) Aug. 1945 to date Chf. Designing Engr., Sanitation Projects of Servicio Cooperativo Interamericano de Salud Publica; previously graduate student; Engr. Design Office Roosevelt Hospital, Guatemala; Asst. to Chf. Engr., Malaria Control works made by Servicio Cooperativo in Port San Jose, Guatemala.

RASMUSSEN, ALFRED EUGENE, Des Moines, Iowa. (Age 28) (Claims RCA 2.7) Sept. 1941 to date with U.S. Army, being 2d Lt., 1st Lt., Capt., and Major; previously Instrumentman, Contact Engr., Inspector, and Office Engr., Natural Gas Pipeline Co. of America.

1941 GRADUATES

GA. SCHOOL TECH.
(B.S. in Arch. Eng.)

	Age
ALTOBELLIS, JULIAN ARTHUR	(26)

ORE. STATE COLL.
(B.S.)

GALLAGHER, JAMES ANDREW, JR.	(27)

1942 GRADUATES

MANHATTAN COLL.
(B.C.E.)

FLYNN, JOHN MILES, JR.	(26)

1943 GRADUATE

UNION COLL.
(B.S. in C.E.)

MACOMBER, RONALD GIBBS	(24)

1944 GRADUATE

RENS. POL. INST.
(B.C.E.)

WATKINS, JOHN THOMAS	(24)

1945 GRADUATE

CORNELL UNIV.
(B.C.E.)

ROWLEY, LYLE BISHOP	(21)

MASS. INST. TECH.
(B.S. in C.E.)

GONZALEZ-RUBIO, ELBERTO, JR.	(24)

UNIV. OF ILL.
(B.S. in C.E.)

JACK, RONALD ALEXANDER	(21)

OKLA. A. AND M. COLL.
(B.S. in C.E.)

MARTIN, CLARENCE KEITH	(24)

PURDUE UNIV.
(B.S. in C.E.)

HEALY, JOHN JOSEPH	(20)
KINDEL, WILLIAM EUGENE	(20)
LINDLEY, JOHN FRANCIS	(20)

1946 GRADUATES

CALIF. INST. TECH.
(B.S.)

SHEPARD, ELMER RALPH	(20)
MEIXNER, GEORGE DONALD, JR.	(20)
FOGTE, ROBERT WARREN	(20)

UNIV. OF FLORIDA
(B.C.E.)

CHERRY, JOHN ROBERT	(26)

UNIV. OF ILL.
(B.S. in C.E.)

AMEEL, ALAN JOSEPH	(20)
BERKEL, CHARLES JOHN	(20)
BIGGERS, JOHN TOLLIE	(20)
CHALKER, WILLIAM RANDOLPH	(20)
GITRE, JERRY LEO	(20)
GROSSELL, ARMIN JAMES	(22)
HEBENSTREIT, RICHARD HENRY	(20)
LEVEY, BERTRAM	(21)
LITVIN, ROBERT LOWELL	(20)
MASHAW, LANE HICKS	(20)
PAYDEN, NEAL FRANKLIN	(25)
PICKETT, JESSE MALCOLM, JR.	(20)
PUNDERSON, ROBERT PRUETT	(20)
REINHARD, ROBERT FREDERICK	(25)
ROLLER, MAX EUGENE	(23)
SEYLER, JIMMY WARREN	(21)
SMITH, RICHARD LEROY	(20)
STONE, RAYMOND MAURICE	(20)
TURNER, HAROLD EUGENE	(21)
WALSTON, ELMER JAMES	(20)

UNIV. OF KANS.
(B.S. in C.E.)

KENNY, FOREST ROBERT	(23)

MO. SCHOOL OF MINES
(B.S. in C.E.)

MATHEWS, RALPH ANDREW	(24)

PA. STATE COLL.
(B.S. in Arch. Eng.)

KUDROFF, MARVIN JAMES	(22)

YALE UNIV.
(B.E.)

BUCH, GEORGE QUENTIN	(20)
GADZIK, JOHN STANLEY	(24)
MEHRING, EDMUND KENNETH ROBERT	(20)
QUIMBY, CHARLES FREDERICK, JR.	(20)
WARNER, BRAINARD HENRY, III	(20)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

RECENT BOOKS

New books donated by the publishers and filed in the Engineering Societies Library, or in the Society's Reading Room. Notes regarding books are taken from the books themselves, edited by the staff of the Society or of the Library. Books in the Library may be borrowed by mail by Society members for a small handling charge.

HYDRODYNAMICS, 6 ed. By Sir H. Lamb. Dover Publications, New York, 1945. 738 pp., diagrs., tables, 9 × 6 in., cloth, $4.95. This is a reprinting of the sixth edition of this standard work on the classical theories of the dynamics of liquids and gases. These important theories, which underlie many present-day practical applications, are dealt with thoroughly and with mathematical rigidity. Among the special topics considered are the motion of solids through a liquid, vortex motion, and tidal waves.

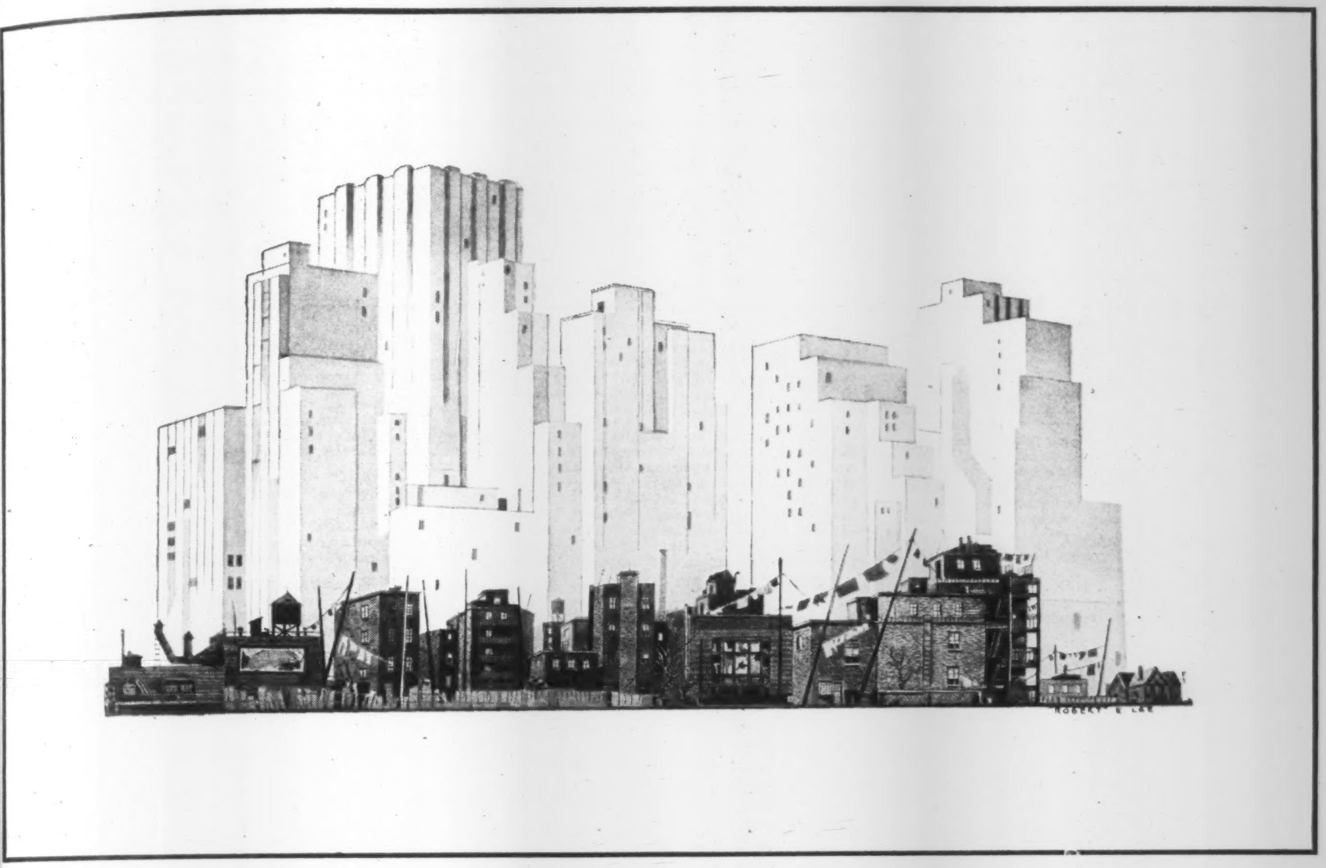
National Research Council, **HIGHWAY RESEARCH BOARD**, Proceedings of the Twenty-fourth Annual Meeting, 1944. Edited by R. W. Crum and F. Burggraf. National Research Council, 2101 Constitution Ave., Washington, D.C., 1945. 543 pp., illus., diagrs., charts, tables, 9¾ × 6½ in., cloth, $5. Some fifty papers and reports are included in this annual volume, broadly classified under the following headings: economics, finance, administration; design; materials and construction; maintenance; traffic and operations; soils investigations; and special projects. A wide range of topics is covered with many examples from actual practice. The volume also contains brief information about the activities of the Highway Research Board.

PRACTICAL DESIGN HANDBOOK FOR ENGINEERS. By A. Cibulka. Clarke & Courts, Houston (Tex.), 1945. Paged in sections, diagrs., charts, tables, 12 × 9 in., paper, $6. The earlier edition of this compilation of design data and formulas covered the following: Strength of materials; steel and concrete structures; pressure and vacuum vessels, piping and metals; hydraulics and heat transfer; mathematical tables and general engineering formulas. The book now includes the formerly separate publications on aerial cable tramways, refinery piping, and modern welded steel structures "RST." Material has also been added on Vierendeel bridges, television towers, hangars, prestressed concrete tanks, hydraulic dams, and the construction of nomographs. Most of the material is in the form of tables and charts, with such explanation as is considered necessary.

RAILROAD AVENUE, Great Stories and Legends of American Railroading. By F. H. Hubbard. McGraw-Hill Book Co., Whittlesey House Division, New York and London, 1945. 374 pp., illus., maps, 9 × 6 in., cloth, $3.75. The author of this new book on railroading and railroaders has collected his material with an eye for the entertaining. Among the stories and legends are authoritative versions of old favorites, as well as a variety of lesser-known and obscure items from the full history of the period. The book is well illustrated by contemporary portraits, drawings, and photographs.

STEELWAYS OF NEW ENGLAND. By A. F. Harlow. Creative Age Press, New York, 1946. 461 pp., illus., 8¼ × 5¼ in., cloth, $3.50. First of a projected series covering the American railroads, this book presents a detailed history of the many roads, important or otherwise, which occupied the New England scene. Beginning with the first horse-operated line out of Quincy, Mass., in 1826, the author depicts the struggles, successes, and failures incidental to the growth of the present-day network which serves the New England States. A thirteen-page bibliography and a detailed index add to the value of the book.

TABLES OF ASSOCIATED LEGENDRE FUNCTIONS. Prepared by the Mathematical Tables Project, conducted under the sponsorship of the National Bureau of Standards, L. J. Briggs, Director, and A. N. Lowan, Project Director. Columbia University Press, New York, 1945. pp. xlvl + 306, tables, 11 × 7¼ in., cloth, $5. Legendre functions are encountered in the general solution of the differential equations of wave motion and the potential theory in spherical coordinates. The present volume of a series of mathematical tables was produced to meet needs for a table of Legendre functions to about six significant figures at intervals of 0.1. Further work is to be done to improve the process of interpolation of these functions.



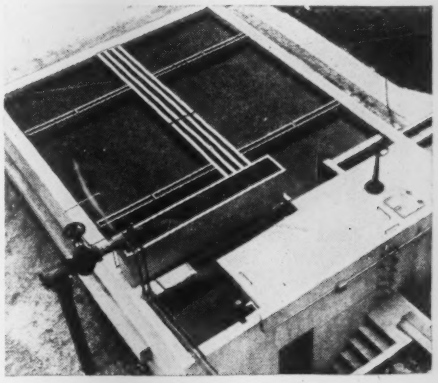
Where's the water going to come from?

FOR the housing development that is to rise on the slum clearance site . . . for the municipal swimming pools . . . the new industries—for the scores of demands soon to be made on the water supply of the postwar community, better water and, quite probably, *more* water is going to be needed.

The ideal water for industry and householder, of course, is soft . . . clear . . . iron-free. Permutit* equipment provides this kind of water. When space is at a premium, compact Spaulding Precipitators or Spiractors not only offer the most modern form of lime soda treatment, but cut space requirements to one half or even one *quarter* of older style water treatment plants.

Find out how Permutit can serve your community. Full particulars will be furnished gladly to you or your consultants. Write to The Permutit Company, Dept M4, 330 West 42nd Street, New York 18, N. Y. or Permutit Co. of Canada, Ltd., Montreal.

*Trademark Reg. U. S. Pat. Off.



PERMUTIT SPAULDING PRECIPITATOR removes water hardness, dirt and color by the sludge blanket process. This new-design equipment cuts detention time, saves chemicals, takes only half the space of former methods. Present installations handle up to 120,000,000 gallons daily.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

Engineering Societies Personnel Service, Inc.

New York
8 W. 40 St.

Chicago
211 W. Wacker Dr.

Detroit
100 Farnsworth Ave.

San Francisco
57 Post St.

The items listed below have been furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the Four Founder Societies. This service is available to members and is operated on a cooperative, non-profit basis. In applying for positions advertised by the Service the applicant agrees, if actually placed in a position through the Service as a result of these advertisements, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient non-profit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office.

A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

Men Available

Civil Engineer; Jun. ASCE; B.S., 1938; age 31; single; engineer officer recently separated from the U.S. Army. American citizen of Chinese extraction. Experience in engineering personnel and office management. Formerly with U.S. Engineers on flood control and highway work. Desire eventual placement in China with American engineering firm with interests in China. Available for training in company on engineering procedures and policies. C-247.

Civil Engineer; Jun. ASCE; B.S. in C.E.; C.E.; age 29, married; 3 years' experience in soil stabilization and soil mechanics research; administrative experience; able to direct work; desire position in highway construction. Detailed qualifications upon request. Available in July. C-248.

Engineer-Executive; M. ASCE; 18 years' experience in planning and executive direction of construction. Successful in organization and administration of technical and administrative personnel. Energetic, excellent health, can produce. Wide contacts in engineering, construction, Army, and Government. Interested in joining firm of engineers or contractors as partner or associate. C-249.

Colonel; Assoc. M. ASCE; age 36; B.C.E., 1932; law diploma (extension) 1943. Registered civil engineer and land surveyor; 5 years in executive position in Army; $1\frac{1}{2}$ years in civil affairs in Orient; 9 years on highway construction and surveying. Desire position in engineering sales or personnel administration. Available April 1. Location, immaterial. C-250.

WANTED

Civil Engineer, Architect or equivalent experience, capable of practical application and original thinking for research on building material uses in Research and Development Department of progressive expanding organization, producing building materials. New York Metropolitan area.

Send résumé to

Box Number 1616
℅Civil Engineering
33 West 39th Street
New York 18, N. Y.

Civil Design Engineer; Assoc. M. ASCE; 20 years' experience in design of dams, spillways, power houses, appurtenant reinforced concrete structures, outlet works, penstocks, tunnels, pipe lines. Work consisted of preliminary and final design, supervision of design, preparation of estimates, administration. Desire position with future, preferably East or South. Salary dependent upon future and location. C-251.

Engineer; Jun. ASCE; age 28; married; B.S. in C.E.; registered; veteran; one year of experience in highway construction and sanitary engineering; $4\frac{1}{2}$ years' industrial engineering, Ordnance Department, U.S. Army. Later assignment entailed plant administration, quality control, inspection, research, and preparation of specifications. Desire position in engineering or inspection department of industrial plant or field work on construction. Southwestern United States preferred. C-252.

Civil Engineer; Jun. ASCE; age 24; married; graduate C.E., 1943; $1\frac{1}{2}$ years' experience in engineering office of structural steel concern; $2\frac{1}{2}$ years' service with the Corps of Engineers. Desire position in design and field investigation work with municipality, industry, or consulting engineer. Available immediately. C-253.

Lt. Commander, CEC, U.S.N.R.; Assoc. M. ASCE; graduate; 44; married; 15 years as engineer in charge of the design and construction of land development organization, including roads, water supply, sewerage, waterfront, buildings, etc.; 2 years foreign work on highway, waterfront, water supply, and airport construction; and 3 years overseas on U.S. Navy technical assignments. Available immediately. Desire permanent connection. C-254.

Civil Engineer; Jun. ASCE; age 29; single; graduate of Georgia School of Technology, 1938; 5 years as officer in U.S. Army Air Corps; 18 months' experience in construction of steam power plants; 18 months' experience in general construction work. Desire position with consulting engineering or contracting firm located in Southeastern states. C-255.

Structural Designer; Jun. ASCE; 26; B.S. and M.S. in C.E.; married; 2 years' teaching experience; 1 year in aircraft design; 2 years on design of all types of construction; specialized in indeterminate structures. Location, Western states only. C-256.

Major, Corps of Engineers (Reserve); Assoc. M. ASCE; B.S. in C.E.; 41; married; 3 years' highway engineering; 3 years' municipal engineering, including pavements, airfields, sewers, and water distribution systems; 4 years on drainage and flood control; $3\frac{1}{2}$ years in administration of office engineering works; 62 months' active military duty. Desire position in West or Southwest. Professional record available. C-257.

Army Captain, Sanitary Corps; Assoc. M. ASCE; age 41; M.S. in sanitary engineering; 13 years' experience in the operation of water and sewage plants; 3 years in Army sanitation. Desire design position in operation, public health, or with manufacturer of water and sewage works equipment. C-258.

Civil Engineer and Assistant Plant Engineer; Jun. ASCE; 27; C.E. degree, 1941; $1\frac{1}{2}$ years surveying, aerial mapping; 3 years design, estimating, and construction of large aircraft plant and facilities; 6 months Naval ship superintendent. Available upon discharge in May. Location preferred, Midwest, south of Cincinnati and Kansas City. C-259.

Civil Engineer, Assoc. M. ASCE; B.S.C.E. and C.E.; licensed, Massachusetts; 31; married; 7, years, AUS, Corps of Engineers. Assignments involved concrete design, construction, supervision, Post maintenance, preparation of plans and specifications, contracts, and work as office executive. Desire position with engineering firm or as instructor in civil engineering, New England, New York, and Pennsylvania. Available May 1, 1946. C-260.

Civil and Mechanical Engineer; ASCE; married; with 25 years' experience on reservoir and dam construction, pile driving, cofferdam, and other waterfront work. Location preferred, western United States. C-261.

Civil Engineer; Assoc. ASCE; 37; married; 16 years' experience on irrigation design and construction, both sprinkler and gravity. Have permanent position. Desire to locate in the Southwest. Available four months' notice. Complete experience data upon request. C-262.

Graduate Civil Engineer; Jun. ASCE; age 26; 2 years sub-professional experience in hydraulic work with the U.S. Geological Survey; 4 years as Engineer officer in the U.S. Marine Corps. Desire connection with construction or engineering consulting firm. Will be available about May 1, 1946. C-263.

Positions Available

Construction Executive thoroughly experienced in every branch of building construction, estimating, and field work. Must be an able negotiator and capable of assuming full responsibility for large work, public and private. Write stating salary desired. Location, New York, N.Y. W-6657.

Engineer to coordinate and field-train the sales organization of nationally established engineering, construction, and consulting firm. Must have technical sales and sales management background and ability to contact and close important contracts with chief executives and engineers. Permanent. Write giving full details and recent snapshot. Location, Pennsylvania. W-6675.

Engineer Designer, civil, for structural and material-handling work for an old-established mining company. Salary, $4,800 a year. Location, Michigan. W-6710D.

Civil Engineer with experience in soils for highway work. Salary, $3,000 a year. Location, Connecticut. W-6714.

Highway Engineer, civil, with ten years' highway and pavement experience, of which five must have been spent in responsible charge of pavement maintenance in a position similar to that of division engineer for a state highway department. Must be able to design bituminous and concrete pavement mixes and specify procedures for patching, sealing, and extending pavements to withstand specific conditions of use. Traveling involved in Southeastern states. Subject to Civil Service examination. Salary, $4,300 a year. Headquarters, Georgia. W-6725

Civil Engineers, preferably with experience in railroad track maintenance and construction work. Salary dependent upon education and experience. Location, South. W-6732.

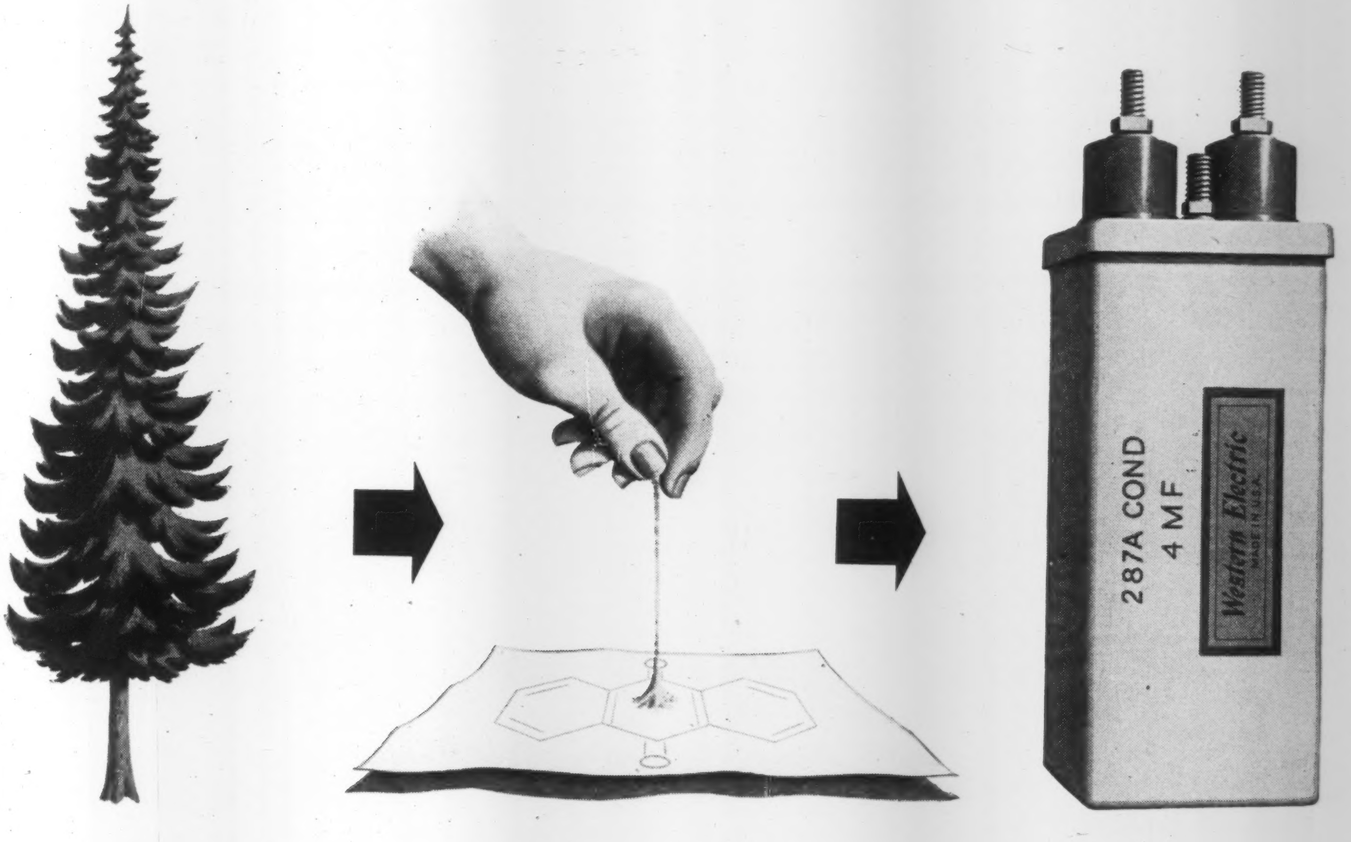
Structural Engineers-Draftsmen for well-established consulting engineering concern. Qualified designers who can and will work out own designs on board. Permanent with one year contract at end of trial period. Monthly salary, vacation, sick leave. Write giving full details of education and experience. Location, Ohio. W-6747D.

Highway Engineer, over 35, with at least 12 years' experience in highway work—at least six of them of top professional grade, such as chief engineer of a state highway department or commission, or minimum ranking of division chief in an organization like Public Roads Administration. Salary open. Location, Washington, D.C. W-6769.

Instructor or Assistant Professor of civil engineering, with at least M.S. degree, to teach hydraulics and fluid mechanics and to develop available laboratory facilities. Must be qualified to teach other civil subjects. Salary, $3,000 up, depending upon experience and qualifications. Location, Middle West. W-6771C.

Civil Engineer, with diversified hydroelectric survey and hydraulic construction experience, to make survey of watershed in India. Salary, $8,000–$10,000 a year. Interviews will be given in New York. W-6777.

LIFE-EXTENSION BY THE GRAM



Crucial links in every wire and radio system are paper capacitors — rolls of impregnated paper and metal foil. At least one is in every telephone — and more than 100 million are in the Bell System. A single failure can sever a telephone call, put a costly line out of service. So finding out how to make capacitors stand up longer is one of the big jobs of Bell Telephone Laboratories.

All-linen paper was once the preeminent material. Then wood pulp was tried — and found to last longer under heat and direct voltage. But why? Something in the wood was helping to preserve life. What was it?

Ultra-violet light, delicate microchemical analysis and hundreds of electrical tests gave a clue. Researchers followed it up—found the answer by treating the impregnated paper with anthraquinone—a dye intermediate. A mere pinch of the stuff prolongs capacitor life by many precious years.

When war came, great quantities of capacitors were needed for military equipment, where failures could cost lives, lose battles. The Western Electric Company, manufacturing for the Bell System, willingly disclosed the life-preserving treatment to other manufacturers. Today in communication capacitors, the new "life-extension" is helping to give more dependable telephone service.

Day by day, resources of this great industrial laboratory are being applied to perfect the thousands of components which make up the Bell System.

BELL TELEPHONE LABORATORIES *EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE.*

Construction Superintendent, with experience in concrete and its application to building construction. Must have good personality and be able to maintain good relationship with general contractors and architects' representatives. Salary open. Location, New York, N.Y. W-6788.

Chief of Party, civil graduate, who has had experience in the surveying of large tracts of land. Must be qualified to tie in calculations, etc. Knowledge of Spanish desirable. Salary, $3,000–$3,600 a year, plus subsistence and other allowances. Location, Venezuela. W-6795.

Structural Steel Sales Engineer. Should have had at least 3 to 5 years' background in drafting and fabricated steel, for sales and estimating. Salary, $4,000–$5,200 a year. Headquarters, Connecticut. W-6799.

CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Publications (Except Those of the American Society of Civil Engineers) in this Country and Foreign Lands

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article, from your own file, from your local library, or direct from the publisher, or they may be borrowed from the Engineering Societies Library. Photoprints will be supplied by this Library at the cost of reproduction, 25 cents per page to members of the Founder Societies (30 cents to all others), plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

Concrete Frame. Design of One-Span Rigid-Frame Concrete Highway Bridges, L. Loch. *Roads & Bridges*, vol. 83, no. 12, Dec. 1945, pp. 51–54, 114–117. Simplified design analysis by method of moment distribution, demonstrated by complete numerical example.

Concrete, Maintenance and Repair. Repair of Flood-Damaged California Bridges. *Pub. Works*, vol. 76, no. 12, Dec. 1945, pp. 23 and 42. How California State Highway Department repaired two reinforced concrete bridges whose piers had been undermined by flash floods.

Concrete, West Point, Va. Precast T-Beams Form 33-Span Bridge. *Concrete*, vol. 54, no. 1, Jan. 1946, pp. 2–3. Illustrated description of highway bridge across Mattaponi River at West Point, Va.; reinforced concrete deck consists of T-beams pre-cast on shore; technical details of construction work, piles, and concrete mixture given.

Design. Two Problems in Bridge Design, L. T. Wyly. *Am. Ry. Eng. Assn.—Bul.*, vol. 47, no. 454, Sept.–Oct. 1945, pp. 27–53. General solutions presented for analysis of rigid frame action due to floor beam deflection and to lateral loads on portals; typical examples are investigated; conclusion is reached that such stresses are frequently fairly high, and recommendation is made that design specifications should provide for computation of such stresses and for proportioning of material for them in rational manner.

Floors. Tests on New Type Open Bridge Floor, H. C. Tammen and C. W. Muhlenbruck. *Eng. News-Rec.*, vol. 135, no. 26, Dec. 27, 1945, pp. 890–891. Load tests on new type of open steel flooring verify calculations that deep distributing trusses materially reduce proportion of wheel load carried by any one flooring beam; results of skid tests on painted and galvanized flooring, both plain and knurled, are also given.

Guard Rails. Design of Better Bridge Railings, M. Deuterman. *Eng. News-Rec.*, vol. 136, no. 2, Jan. 10, 1946, pp. 68–71. Satisfactory bridge railings must be strong, sufficiently high, rapidly visible, provide adequate clearances, and present continuous smoother barrier to traffic; at same time railing should be attractive in appearance and cause minimum of interference to view from bridge; how three functional parts of railing, curb, rails, or horizontal barrier, and posts or vertical supporting members, can best be designed to meet these varied requirements is discussed.

Highway, Maintenance and Repair. How Parts of Large Pin-Connected Truss Were Replaced Without Falsework, H. S. Rockoff and F. H. Stowell. *Roads & Streets*, vol. 88, no. 11, Nov. 1945, pp. 69–72 and 89. Temporary U-bar members were looped around adjacent pins while corroded bottom chord and diagonal members and pins were replaced; hydraulic jack, torch and welding outfit among simple tools employed.

Highway, Maintenance and Repair. Maintenance and Repair of Concrete Bridges on Oregon Highway System, G. S. Paxson. *Am. Concrete Inst.,—J.*, vol. 17, no. 2, Nov. 1945, pp. 105–114. Official of Oregon State Highway Dept. describes types of concrete disintegration and methods and materials for repair and replacement; protection against deterioration; illustrations reveal types of damage.

Natural Gas Pipe Lines, River Crossings. Largest Pipe Line Bridge Completes Carthage Outlet, H. A. Hess. *Oil Weekly*, vol. 120, no. 8, Jan. 21, 1946, pp. 33–39. Illustrated description of suspension bridge crossing Red River, on 142-mile 24-in. line of United Gas Pipe Line Co. from Carthage gasoline plant to point of connection with Tennessee Gas and Transmission system near West Monroe, La.; total elevated section of pipe, or distance between rest towers is 3,200 ft, with distance of 1,600 ft between main supporting towers; another 422 ft on each side separates rest towers from anchors, making over-all length of 4,040 ft between anchors.

Piers, Maintenance and Repair. Dry Packing and Grouting of Substructure Salvages 90-Year-Old Montreal Bridge. *Eng. News-Rec.*, vol. 136, no. 2, Jan. 10, 1946, pp. 32–34. Grouting under pressure successfully used to replace mortar and solidify masonry of piers built in 1854 for bridge across St. Lawrence River; deteriorated stones in exterior masonry replaced by packing with crushed stone and intruding grout into it; long approach abutments have been strengthened by forming new arch underneath original by dry packing crushed stone against arch and forcing grout into it to make concrete.

Piers, Reconstruction. Ingenious Pier Replacement Saves Failing Bridge, W. J. LaFleur. *Construction Methods*, vol. 27, no. 12, Dec. 1945, pp. 98–101, 162, 164, and 166. Methods used in replacing pier are described; steel pile groups were driven at two ends of faltering bridge pier, and truss spans were transferred to permanent cross girder resting on concrete caps of new pile groups, without closing bridge to traffic.

Plate Girder, South Carolina. Continuous Steel Girder Bridge Spans Santee-Cooper Tailrace, W. J. Gooding. *Eng. News-Rec.*, vol. 136, no. 4, Jan. 24, 1946, pp. 120–122. Continuous plate-girder highway bridge built across tailrace of Santee-Cooper power project was designed for 20,000 lb per sq in. unit steel stress, and to better accommodate necessary skew of piers, four lines of girders rather than two were used, floorbeams and stringers being eliminated; crawler crane on barge assisted by second rig on deck-erected 112 by 140 by 112-ft central unit and two-span end units.

Steel Truss, Illinois. Solves Problems on Its Cairo Bridge. *Ry. Age.*, vol. 120, no. 3, Jan. 19, 1946, pp. 182–185. Illinois Central Railroad eliminates rail end batter on span with heavier continuous welded rail, and stops tie-plate cutting and resultant wide gage on approach curve by placing Fabreeka pads under tie plates.

Suspension, Great Britain. Menai Bridge Reconstruction, G. A. Maunsell. *Instn. Civ. Engrs.—J.*, vol. 25, no. 3, Jan. 1946, pp. 165–193, (discussion) 193–206. Illustrated description of original bridge between Wales and Island of Anglesey, Great Britain, its history, reconstructions in 1839, 1893, and 1940, technical details, practical execution of alterations, cost, etc.; appendix contains peculiarities of old structure.

BUILDINGS

Concrete, Earthquake Resistance. Earthquakes and Earthquate Resisting Structures, J. Kulik. *Civ. Eng.* (London), vol. 40, no. 472, Oct. 1945, pp. 229–230, 232, and 234. Rossi-Forel scale for measuring intensity of earth tremor, and characteristics of seismic waves discussed; influence of layout and height of buildings, materials and subsoil conditions considered; suggestions for calculation of stability made, but indications that known methods of calculation do not ensure complete safety in case of major earth tremor. English translation from *Ingenieria*, April 1944.

Structural Steel. Nailable Steel Speeds Construction. *Western Construction News*, vol. 20, no. 12, Dec. 1945, pp. 89–90. Nailable steel, which was used in construction of Quonset Huts during war, is available for light industrial and residential building; 2 thin-gage plates are curved, leaving groove that is width of nail; as nail is forced between sheets, it is deformed and clinched fast.

Timber-Steel. Timber-Steel Combined in School Building Design. *Western Construction News*, vol. 20, no. 12, Dec. 1945, pp. 83–85. Selected for its economical features by Palo Alto, Calif., school district, unique design combines steel columns and timber beams and bracing members to form earthquake and fire resistant structure of unusual durability.

CITY AND REGIONAL PLANNING

Great Britain. Creation of New Town, J. F. Eccles. *Surveyor*, vol. 105, no. 2816, Jan. 11, 1946, pp. 23–26. Discussion of items to be taken into consideration in connection with creation of new town of about 60,000 inhabitants; basic assumptions, contour plan, drainage, sewage disposal, supply of water, electricity and gas, financial problems, residential, industrial, and shop districts, and religious and recreational facilities are considered. Before Town Planning Inst.

Housing, Great Britain. Conversion of Temporary Wartime Buildings to Housing Use. *Surveyor*, vol. 105, no. 2818, Jan. 25, 1946, pp. 62–63. Review of circular issued by Ministry of Health, Great Britain, concerning conversion of temporary wartime buildings to housing use; conditions of procedure discussed.

CONCRETE

Beams and Girders. Concrete Joists for Commercial and Residential Construction. *Am. Bldr. & Bldg. Age*, vol. 68, no. 1, Jan. 1946, pp. 82–85. Describes use of prefabricated Lith-I-Bar joists in lengths up to 36 ft featuring light weight, fire safety, improved concrete quality, and adaptability to all types of construction.

Construction, Cold Weather Problems. Effect of Freezing and Thawing on Concrete Pavements. *Roads & Bridges*, vol. 84, no. 1, Jan. 1946, pp. 65–68, 90, 92, 94–100. Report covering results of laboratory study carried out by Highway Research Board, Washington, D.C.; materials, mixing, molding, curing, and testing described; influence of freezing and thawing on properties of concrete (modulus of elasticity, flexural and compressive strength, dynamic modulus, etc.) discussed; appearance of specimens after freezing and thawing, effect of air content, prolonged moist curing, dried coarse aggregate, and water curing considered.

Construction, Forms. Progressive Concrete Shuttering, L. E. Hunter. *Civ. Eng.* (London), vol. 40, no. 472, Oct. 1945, pp. 220–223. Advantages and cost of traveling form for construction of sea walls, culverts, and sewers discussed; economy of vertical lift shuttering for plain wall construction stressed; application of progressive shuttering to chimney construction by reducing circumference described.

Floors. Design of Concrete T. Beam Floors. W. S. Wilson. *Civ. Eng.* (London), vol. 40, no. 473, Nov. 1945, pp. 251–255. Formulas developed for design and stress analysis of reinforced-concrete T-beams; theory applied to

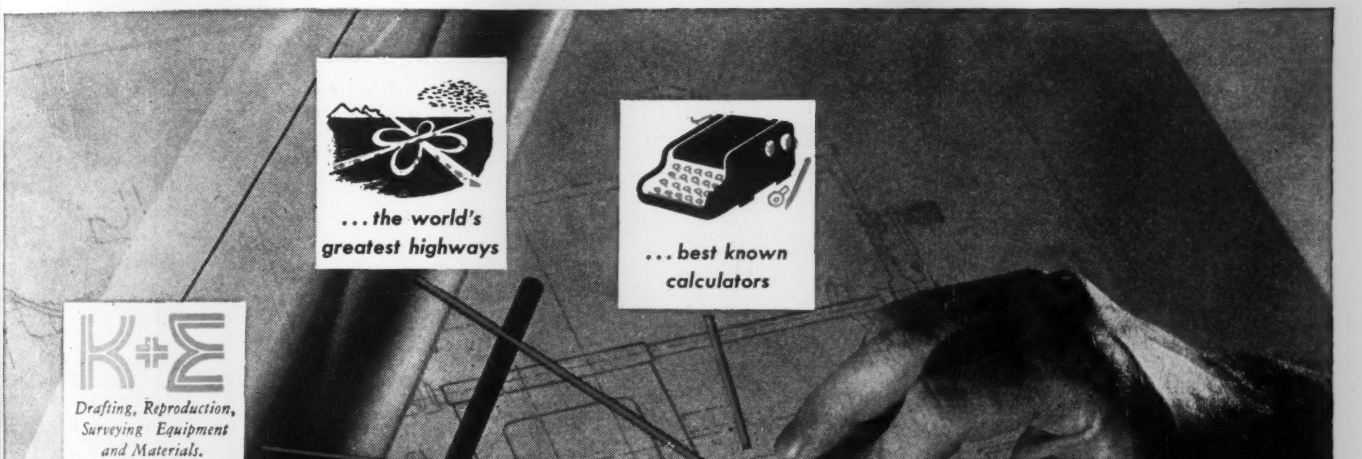
partners in creating

●So clearly and unmistakably are draftsmen able to express their ideas on paper that their drawings have re-shaped the world. Through line, figure and symbol, draftsmen define the work to be done by the labor and machines of a nation. Assisting them to attain precision and clarity are drafting instruments that act almost as living extensions of their own hands...instruments that function figuratively as their partners in creating.

For 78 years Keuffel & Esser Co. drafting equipment and materials have been partners, in this sense, in shaping America, in making possible its swift-moving highway traffic, its speed in conducting business, its victorious might in war ... So universally is K & E equipment used, it is self-evident that every engineering project of any magnitude has materialized with the help of K & E. Could you wish any surer guidance than this in the selection of your own "drafting partners"?

You will find special advantages, for example, in PHOENIX* Tracing Cloth, which K & E has made almost "ghost-proof." Here is a cloth from which you can erase either pencil or ink lines without risking untidy "ghosts" on the prints, a cloth practically immune to stains from perspiration and water. You can even soak it in water for ten minutes at a time without harm! For further details about PHOENIX* Tracing Cloth, write on your letterhead to Keuffel & Esser Co., Hoboken, N. J.

*REG. U. S. PAT. OFF.



... the world's greatest highways
... best known calculators
K+E
Drafting, Reproduction, Surveying Equipment and Materials. Slide Rules, Measuring Tapes.
... newest rockets

KEUFFEL & ESSER CO.
EST. 1867
NEW YORK • HOBOKEN, N. J.
CHICAGO • ST. LOUIS • DETROIT • SAN FRANCISCO
LOS ANGELES • MONTREAL

numerical examples; values for simplification of computation work listed in table.

Mixing. Design of Concrete Mixes, L. A. Thorssen. *Roads & Bridges*, vol. 84, no. 1, Jan. 1946, pp. 63–64, 114, 116–118. Scientific basis of proportioning of amounts of cement, aggregates and water explained; importance of water-cement ratio stressed and its influence on strength of concrete discussed; proportioning by means of trial mix; procedure of adjustment described and effect of errors in determination of moisture content during mixing operations considered. First refresher course in soil mechanics and concrete at University of Alberta.

Permeability. Permeability of Concrete, L. B. Mercer. *Commonwealth Engr.*, vol. 32, no. 12, July 2, 1945, pp. 349–357, vol. 33, no. 1, Aug. 1, pp. 12–17 July 2: Theoretical considerations and laboratory test methods; details of experimental work with new apparatus. August 1: Conclusions from tests; influences of various factors as cement grade, size of aggregates, and curing are discussed; permeability of concrete structures is considered, referring to percolation paths and fallacy of low water-cement ratio.

Reinforcement, Welding. Investigation of Strength of Welded Stirrups in Reinforced Concrete Beams, O. Moretto. *Am. Concrete Inst.—J.*, vol. 17, no. 2, Nov. 1945, pp. 141–162. Results of tests of reinforced concrete beams with stirrups welded to longitudinal reinforcement are presented, and size and inclination of stirrups and type of concrete studied; effect of welded and loose stirrups compared and discussed.

Roads and Streets. Hoosier Concrete Job Spotlights New Air Entrainment Specifications. *Road & Streets*, vol. 88, no. 12, Dec. 1945, pp. 57–62. Illustrated report on paving practice with air-entraining concrete near Ft. Wayne; mixing, placing, finishing; description of mechanical paver and other equipment; test to determine quantity of trapped air in fresh concrete with use of air-entraining portland cement; adopted by Indiana State Highway Commission in 1945; details of pavement cross section presented by sketches.

Waterproofing. Concrete Waterproofing, L. E. Hunter. *Civ. Eng.* (London), vol. 40, no. 474, Dec. 1945, pp. 275–278. Types of structures requiring concrete waterproofing and necessary properties of cement and aggregates discussed; various methods of waterproofing and waterproofers described; notes on tests made by U.S. Bureau of Standards on surface waterproofing agents, such as asphalt emulsion, bituminous solutions, iron compounds, various paints, and varnishes.

DAMS

Construction. Novel Bulkhead Pick-Up Device Eliminates Need for Diver, W. E. Sidney. *Eng. News-Rec.*, vol. 136, no. 4, Jan. 24, 1946, p. 117. Description of device used for handling emergency bulkheads at Montgomery Island and Emsworth Dams in Pittsburgh District; pick-up device attaches to bulkhead at each end by means of pin 4 in. in diameter sliding horizontally through end plates to engage hole in bulkhead lifting lugs.

Earth, Colorado. Shadow Mountain Dam, N. R. Love. *Western Construction News*, vol. 20, no. 12, Dec. 1945, pp. 75–78. Earth-fill, rock-faced dam will provide water storage for release into Adams Continental Divide tunnel; dam and dike total 3,100 ft in length, and main dam is protected by cut-off wall 27 ft deep.

Foundations. Influence of Geology on Construction of Impounding Dams, E. Morton. *Surveyor*, vol. 104, no. 2811, Dec. 7, 1945, pp. 759–760. Measures that have to be taken with respect to unconsolidated superficial deposits, and underlying solid rocks in order to secure stability and relative water-tightness of dam. Abstract of paper before Instn. Water Engrs.

Grouting. La Impermeabilizacion por Inyecciones del Embalse del Tranco, L. Aldaz Muguiro. *Revista de Obras Publicas*, vol. 93, no. 2762, June 1945, pp. 254–259. Impermeabilizing Tranco Dam by grouting; dam on Guadalquivir River, below confluence with Hornos River is 90 m high and has impounding capacity of 550 million cu m; seepages through fissures in limestone, particularly in faulted area, tend to increase as limestone dissolves; unless grouted before reservoir fills, flow of water may wash out cement before it sets; illustrated description of practice, including test borings.

Hydraulic Fill, Nebraska. Kingsley Dam Gets New Stone Facing. *Eng. News-Rec.*, vol. 136, no. 2, Jan. 10, 1946, pp. 29–31. Pre-cast concrete riprap installed in 1941 on Kingsley Dam, near Ogallala, Nebr., failed to prevent unforeseen disastrous wave wash scour on upstream face of hydraulic fill; all old riprap above lake level is being removed and replaced with 3-ft layer of quarried stone riprap.

Reservoirs, Lining. Asphaltic Reservoir Linings Prove Successful, A. H. Benedict. *Pub. Works*, vol. 76, no. 12, Dec. 1945, pp. 15–157, 36, 38, 40, and 42. Use of asphaltic concrete for waterproofing hydraulic structures; standard conditions to be considered are slope of side bank, type of soil, and type of waterproof construction and method of laying it.

FLOOD CONTROL

Shore Protection. Corps of Engineers Introduces New Type of Revetment on Lower Mississippi, A. B. Pickett. *Concrete*, vol. 53, no. 12, Dec. 1945, pp. 14–15, 24, and 26. New-type mat made of concrete, reinforced with wire mesh fabric, is being used for bank protection on Mississippi River; construction details of mats and protecting procedure described.

FOUNDATIONS

Airports, Charleston, W. Va. Kanawha Airport Construction Involves Heavy Grading. *Pub. Works*, vol. 77, no. 1, Jan. 1946, p. 40. New airport near Charleston, W.Va., involved nearly 10 million cu yd of excavation; details of construction, rock excavation, equipment, and drainage given; 3 runways, up to 6,000 ft long, will be paved to width of 150 ft with native stone base and bituminous concrete wearing surface.

Concrete. Design Data for Concrete Founds, W. S. Wilson. *Surveyor*, vol. 105, no. 2815, Jan. 4, 1946, pp. 11–12. Data given on design of concrete foundations with aid of simple formulas derived from considerations of bending and shear; depth required can be read from charts; numerical examples presented.

Excavation, Accident Prevention. Army Safety Requirements for Excavations. *Pub. Works*, vol. 77, no. 1, Jan. 1946, pp. 29–30. Standards for good practice in trench excavation prepared by Safety and Accident Prevention Div. of Corps of Engrs.; methods of starting sheeting for trenches, sheeting for deep trenches and bracing for hard material presented.

Soil Surveys. Foundation Problems and Geology, A. Roberts. *Civ. Eng.* (London), vol. 40, no. 472, Oct. 1945, pp. 226–228. Various subsoil conditions (clay, sands and gravel, solid rock) discussed and their influence on foundations, such as heave in neighborhood of excessively loaded clay layer, flow of clay and sand, etc., considered.

Soils, Consolidation. Chemical Injections Solidify Soil to Stop Foundation Settlement. *Construction Methods*, vol. 27, no. 12, Dec. 1945, pp. 78–79, 156, 158, 160, and 162. To stop settlement of heavy mill engine and crusher foundation resting on water logged, medium fine sand, pipes resembling well points are driven from working trench outside building into area below concrete mat, and chemicals are injected under pressure through these pipes to form gel which hardens rapidly to transform soil into hard insoluble mass.

HYDRAULIC ENGINEERING

Shore Protection, Model Tanks. Report on Chicago Wave Tank Experiments, J. J. O'Rourke. *Shore & Beach*, vol. 13, no. 2, Oct. 1945, pp. 30–37. Chicago Park District Wave Tank is located under seats of Soldier Field; its purpose is to test models of shore-protection structures designed by Engineering Dept. before they are built. Tank was designed to operate on scale of 80 to 1; it is 103 ft long, 45 ft wide, with walls 18 in. high; wavemaker consists of variable speed, motor-driven train of gears, directly connected to wooden paddle board.

HYDROELECTRIC POWER PLANTS

India. Electric Power Development in C.P. and Berar, D. J. Badkas. *Electrotechnics*, nos. 17 & 18, Sept. 1945, pp. 59–74. Part I lays down basic needs of Central Province; modern trend in power expansion in advanced countries is recounted; economic limits of hydro plants in comparison with thermal plants; benefits of combined irrigation and water power projects; Part II presents scheme for power development in Province with special attention to water power development.

India. Note on Papanasam Project, T. R. Chellappa. *Electrotechnics*, nos. 17 & 18, Sept. 1945, pp. 75–77. Salient features of Papanasam project are described; actual data regarding hydraulic works, electrical equipment, protection and transmission lines are included.

HYDROLOGY AND METEOROLOGY

Run-Off. Soil and Water Losses as Affected by Rainfall Characteristics, J. H. Neal. *Agric. Eng.*, vol. 26, no. 11, Nov. 1945, pp. 453–454. Factors which affect runoff can be grouped under two heads, namely, precipitation and watershed characteristics; if rainfall characteristics are known, watershed characteristics can be changed to control soil loss partially, if not runoff; classification of rains; soil losses; adjusting farming practices. Before Am. Soc. Agric. Engrs.

INLAND WATERWAYS

Jetties. Eel River Training Jetties at Shively Bluffs Combat Floods, L. R. Reddem. *Calif. Highways & Pub. Works*, vol. 23, nos. 11–12, Nov.–Dec. 1945, pp. 21–23. Types and functions of permeable pile jetties built to resist erosive action of river along Redwood Highway.

IRRIGATION

Deschutes Project. Deschutes Project—Features Unusual Flume and Tunnels, F. W. Slattery and C. C. Beam. *Western Construction News*, vol. 20, no. 12, Dec. 1945, pp. 79–82. Water impounded behind Wickiup Dam will irrigate some 50,000 acres of central Oregon land never before watered; present construction on project includes outlet works at Wickiup canals, tunnels, and flume crossing of 140-ft deep canyon; much interesting equipment devised to meet war shortages.

Irrigation Canals, Washington. Siphons Feature Yakima Canal, C. L. Tyler. *Western Construction News*, vol. 20, no. 11, Nov. 1945, pp. 92–95. Construction of siphons and waste-ways described.

Near East. Irrigation Problems in Levant States. *Engineering*, vol. 160, no. 4164, Nov. 2, 1945, pp. 345–346. Brief history of developments; description of Kasmieh scheme in Lebanon; new works in progress in Syria; prospects for future developments.

LAND RECLAMATION AND DRAINAGE

Roads and Streets. Design and Capacity of Gutter Inlets, N. W. Conner. *N. Carolina State College Agric. & Eng.—Eng. Experiment Station—Bul. No. 30*, July 1945, pp. 1–32. Illustrated report on experiments performed by Engineering Experiment Station at Raleigh, N.C., securing information on capacity of plain side inlets, inlets with grate, and inlets with deflecting vanes; design must be based not only on hydraulic conditions but also upon limitations imposed by traffic and other factors. Bibliography.

Soil Conservation. Functions of Soil Conservation Districts in Drainage, F. F. Shafer. *Agric. Eng.*, vol. 26, no. 11, Nov. 1945, pp. 456–468. Objectives of districts are to conserve soil, moisture, and related resources; figures given illustrate importance of drainage in upper Mississippi Valley region; accomplishments in drainage, how soil conservation districts aid landowners; advantages of soil conservation district management and operation. Before Am. Soc. Agric. Engrs.

MATERIALS TESTING

Cement Chemistry. Use of Aluminous Cement in Construction of Mosul Tunnel, Iraq State Railways, G. C. Hagger. *Instn. Civ. Engrs.—J.*, vol. 25, no. 2, Dec. 1945, pp. 142–149. For construction of Mosul Tunnel of Iraq State Railways, tests with aluminous cement were performed at Bagdad Chemical Laboratory; study showed that strength of concrete with aluminous cement decreases in close relation to increase in temperature at times of mixing and curing, provided that temperature is within range of 60 to 110 F; technical data on construction of tunnel included in article.

PORTS AND MARITIME STRUCTURES

Breakwaters. Design and Construction of Reinforced Concrete Cribs for Harbour Breakwater, C. E. Hawke. *Eng. & Contract Rec.*, vol. 58, no. 12, Dec. 1945, pp. 42–45, 96–97. Cobourg, Ontario, harbor timber cribwork replaced with three concrete cribs in marine engineering construction job; details of crib design, wall loading, and reinforcement; detailed layout plan presented.

Docks, Port Arthur, Ontario. C.N.R. Builds Large Ore Dock. *Ry. Age*, vol. 120, no. 4, Jan. 26, 1946, pp. 235–238. Description of $2,500,000 facility completed at Port Arthur, Ont., to load boats for shipment to lower Great Lakes ports, which features modern concrete construction and high approach trestle.

Piers, Military. "Swiss Roll" and "Lily." *Engineer*, vol. 180, no. 4681, Sept. 28, 1945, p. 243. Information released regarding two new naval developments based upon inventions of R. M. Hamilton; "Swiss Roll" is floating pier that can be rolled up and carried on board ship until required for use; though nearly 20 times as light as "Bailey" bridge, it is capable of supporting 9-ton truck; "Lily" landing strip consists of numbers of hexagonal buoyancy cans which "give" to motion of sea; since they can be rapidly pinned together, floating "island" of any desired shape can be built up from them.

Pontoons. Navy's Steel Pontoons, R. G. Skerrett. *Compressed Air Mag.*, vol. 50, no. 9, Sept. 1945, pp. 226–232. Article reveals many essential services performed by Laycock steel pontoons; applications in facilitating amphibious operations are illustrated and described, including considerable information on their development, construction, and assembly.

West Africa. Port of Luanda—Striking Recent Development of West African Port, A. De M. Cid Perestrelo. *Dock & Harbour Authority*, vol. 26, no. 301, Nov. 1945, pp. 153–158. Description of port and its harbor; harbor works prior to 1939; work in progress and work planned by Survey Mission; execution of work in hand; equipment and facilities of port; cost of works and allied projects; execution of work in hand; economic possibilities of port of Luanda.

ROADS AND STREETS

Airport Runways. California Airbase Builds Runway for 300,000-Lb Planes, C. J. Gorman. *Construction Methods*, vol. 28, no. 1, Jan. 1946, pp. 109–112. Illustrated and descriptive matter on Fairfield-Suisun field featuring large gross load capacity runway; cross sections of portland cement concrete pavement, and asphaltic concrete surfacing; data on dimensions and quantities of materials.

Airports, Charleston, W. Va. 10,000,000-Yd Earthmoving Job Levels Hills for West Virginia Airport, L. S. Wescott. *Construction*

How a B-G Travel Plant Gives You Two Advantages

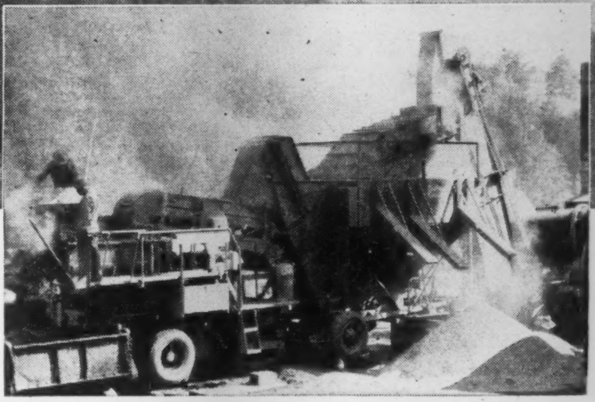
● Low costs per yard and a high quality mix are two advantages enjoyed by the owners of B-G Travel Plants.

The B-G Paving Bucket Loader and Portable Mixer team up to form this high-capacity, portable unit. Its accuracy in proportioning, measuring and mixing means a far better road-mix than is possible with ordinary "on-the-road" units.

The second important advantage is the fact that with this B-G Travel Plant you can cut your yardage costs through the use of low-cost local materials.

There are many other Barber-Greene constant-flow units for mixing and placing bituminous mix—and for cement and soil stabilization. Like this Barber-Greene Travel Plant they might well help you bid for, and get, more profitable jobs. Write for the Barber-Greene Catalog No. 848 which describes and illustrates B-G asphalt equipment.

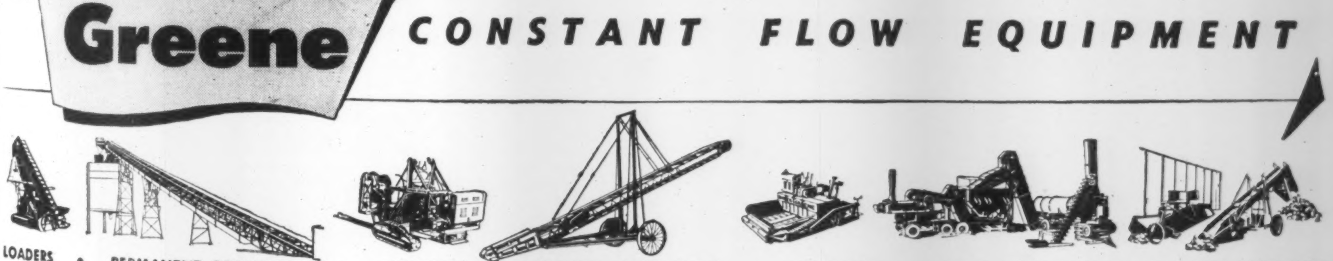
BARBER-GREENE
BARBER-GREENE



• *B-G Mixers serve a dual purpose—as part of the Travel Plant or as an integral unit in a Central Plant set-up shown here. Included is the Gradation Control Unit which accurately proportions aggregate for best quality "high-type" mixes.*

46-12

B-G Barber-Greene CONSTANT FLOW EQUIPMENT


LOADERS
PERMANENT CONVEYORS
DITCHERS
PORTABLE CONVEYORS
FINISHERS
BITUMINOUS PLANTS
COAL MACHINES

Methods, vol. 28, no. 1, Jan. 1946, pp. 86–89, 186, 188, 190, and 192. Illustrated descriptive article, giving some features of Kanawha airport project near Charleston, W.Va., involving grading operations totaling over 9,700,000 cu yd; equipment, financing, and contract details noted.

Airports, Snow Removal. Snow-Handling on Airports. *Roads & Bridges*, vol. 83, no. 12, Dec. 1945, pp. 64–66, 97–99. Methods and equipment used at Royal Canadian Air Force airfields are described.

China-Burma-India. Maintenance of Stilwell Road, W. L. O'Donnell. *Highway Mag.*, vol. 36, Nov.–Dec. 1945, pp. 140–142. Problems in maintenance of 1,080-mile highway include providing lumber and gravel supplies and extension of culverts.

Concrete. Dual-Lane Highway Involves Heavy Grading, Unreinforced Concrete Pavement and Bridge, J. J. Corbett. *Construction Methods*, vol. 28, no. 1, Jan. 1946, pp. 92–93, 136, 140, and 142. Completion of U.S. Route 66 project near Fort Leonard Wood, Mo., involved 4.7 miles of excavation, grading, and concrete paving, and construction of multi-span unreinforced concrete Piney River Bridge carrying two 26-ft roadways; equipment used and specifications noted.

Concrete. North Dakota Builds Unreinforced Pavement of Air-Entrained Concrete. *Construction Methods*, vol. 28, no. 1, Jan. 1946, pp. 84–85, 160, and 164. Illustrated descriptive article of concrete pavement project undertaken by North Dakota State Highway Dept. on 5.81 miles of U.S. 81, using vinsol resin to achieve weight reduction; details of concrete batch.

Coral. Coral—Versatile Construction Material. *Western Construction News*, vol. 20, no. 12, Dec. 1945, pp. 95–96. Coral, extensively used in construction of military installations throughout Pacific, has proved to be excellent material adapted to speedy construction with good wearing qualities, low maintenance, and rework requirements.

Design. Planning Development of Community's Roads. *Better Roads*, vol, 15, no. 12, Dec. 1945, pp. 23–24, 42, 44, and 46. Goal of county highway planning is orderly development of road system to satisfy major community needs; plans should be keyed into national public-works policy; planning tools include maps, road and bridge inventories, traffic and accident data, and estimates of costs and income; planning requires serious study of trends in community development.

Design. Relation of Width of Paved Roadways and Surfaced Shoulders to Safe-Highway Operation. *Pub. Works*. vol. 77, no. 1, Jan. 1946, pp. 25–26. Illustrations and graphs indicating usefulness of frequency distributions of vehicle placements in determining slab thickness and cross section, shoulder width and type, and required surface width for specific traffic conditions. From studies of Public Roads Administration.

Design. Superelevation in Road Construction, R. D. Jennings. *Civ. Eng.* (London), vol. 40, no. 473, Nov. 1945, pp. 246–248. Official of Roads Dept., British Ministry of War Transport, outlines principles for layout and construction of roads in connection with change of cross section from normal camber to full superelevation; theory developed with aid of formulas and graphs.

Expressways and Parkways, Detroit. Expressways and Buses to Relieve Detroit's Traffic Congestion. *Roads & Bridges*, vol. 84, no. 1, Jan. 1946, pp. 49–58, 100–4, 106–108. Detroit, Mich., proposes to spend more than $130,000,000 on expressways within 12 years; article presents illustrations and description of proposed expressways and discusses various expert opinions on this subject; transit plan, proposed by consultants, also taken into consideration.

Expressways and Parkways, Detroit, Mich. Plans Are Progressing on Detroit's John C. Lodge Expressway, L. C. Smith. *Roads & Streets*, vol. 88, no. 12, Dec. 1945, pp. 68–72. General design principles, technical details, financial program, and importance of new expressway discussed.

Maintenance and Repair. Illinois Rebuilds U.S. Highway 66. *Eng. News-Rec.*, vol. 136, no. 2, Jan. 10, 1946, pp. 52–57. Three important requirements of modern highway design are incorporated in new construction on U.S. Highway 66 between St. Louis and Chicago: belt-line construction to by-pass all but smaller towns along highway, limited access and subgrade preparation to prevent future pavement pumping.

Maintenance and Repair. Resurfacing Salvages Pavement on Baltimore–Washington Artery. *Construction Methods*, vol. 28, no. 1, Jan. 1946, pp. 116–118, 192, 194, and 196. Asphaltic concrete surfacing used in improvement of Baltimore–Washington section of U.S. 1; machinery involved, contractors associated, and data on costs.

Maintenance and Repair. South's Biggest '45 Road Job, H. J. McKeever. *Roads & Streets*, vol. 88, no. 11, Nov. 1945, pp. 78–81. Illustrated description of work on Alabama U.S. 11, where 40 miles of reconstruction was effected in five contract sections.

Maintenance and Repair. Special Refinements Aid Operations on Illinois Resurfacing Job. *Construction Methods*, vol. 28, no. 1, Jan. 1946, pp. 94–95, 129, and 132. Article illustrates and describes improved methods developed by Illinois Div. of Highways in 600 miles of resurfacing experience; details of asphaltic concrete mix, equipment employed, and rate of laying.

Maintenance and Repair. States Chart Federal-Aid Secondary Courses. *Better Roads*, vol. 16, no. 1, Jan. 1946, pp. 15–18, 38, and 40. Report on 300,000 miles of state roads as initial stage of secondary system eligible for improvement with federal funds in 1944; data on geographical distribution, system of selection, funds, and on design and supervision of work given.

Maintenance and Repair, Cuba. Cuba Overhauling Central Highway, J. I. Planas. *Roads & Streets*, vol. 88, no. 12, Dec. 1945, pp. 86, 88–90, and 92–93. Illustrated description of Cuba's highways, their original pavement design, and recent condition; data on financing repair program, types and methods of repairs and resurfacing of old asphalt pavement; necessity of experimentation and training of workers stressed.

Maintenance, Tank Traffic. Resistance of Road Surfacings to Tank Traffic, A. R. Collins and D. B. Waters. *Instn. Mun. & County Engrs.—J.*, vol. 72, no. 6, Jan. 1, 1946, pp. 221–240. Investigations into resistance of concrete and bituminous road surfacings to wear by tank traffic; results of tests performed by means of special testing machines presented graphically and numerically; recommendations are given for construction of tank roads using concrete and bituminous materials.

North Carolina. New Road May Modernize Carolina's Coastal Islands. *Better Roads*, vol. 16, no. 1, Jan. 1946, pp. 24 and 29–30. Necessity of building roads in so-called Outer Bank (from 10 to 25 miles off coast of North Carolina) stressed; results of experimental sections discussed; prevailing conditions presented by illustrations.

Postwar, United States. America Plans Post-War Roads. *Roads & Road Construction*, vol. 23, no. 275, Nov. 1, 1945, pp. 345–347. Review of report of "National Interregional Highway Committee," appointed by President Roosevelt in 1941 to investigate need for limited system of national highway and to improve available facilities for inter-regional transportation; system of recommended highways, basic standards and cost discussed and compared with British conditions.

Snow and Ice Control. Ice Formation Along Alaska Highway, W. L. Eager and W. T. Pryor. *Eng. & Contract, Rec.*, vol. 58, no. 12, Dec. 1945, pp. 38–39, 98, 100, 102, and 104–106. Icing on Alaska Highway forms in such manner that its thickness and area are continually increased; this type of icing cannot be entirely prevented by any method that is reasonable in cost; highways in extremely cold climates should be located, designed, and constructed to reduce necessity for icing control.

Soil Cement. Build Soil-Cement Streets in Summer, L. C. Bailey. *Am. City*, vol. 60, no. 12, Dec. 1945, p. 99. Experiences and difficulties encountered in surfacing 5 miles of street approaches to various federal housing projects in Knoxville, Tenn.; work, started in late fall, caused difficulties and long delay in completion on account of bad weather.

Stabilization. Stabilized Roads for Tank Traffic, B. H. Petty. *Highway Mag.*, vol. 36, Nov.–Dec. 1945, pp. 128–130. New roads at Fort Knox, Ky., are built of 3-in. to 2-in. crushed stone graded and rolled to crown, then dry-filled with screenings and rolled to consolidation; application of $1^1/_2$ lb per cu yd of calcium chloride used to set up and harden surface.

Stabilization. Tar Base Stabilization as Practiced on Recent Alabama Project, J. F. Tribble. *Roads & Streets*, vol. 88, no. 12, Dec. 1945, pp. 94–98 and 99. Official of Alabama State Highway Department describes 21-mile tar base stabilization project consisting of tar-stabilized base plus double tar and slab cover; this method believed to be excellent solution for region scarce in local road materials.

Widening. Woodland-Kalama Highway Realignment. *Pac. Bldr. & Engr.*, vol. 51, no. 10, Oct. 1945, pp. 52–53. How Leonard and State, despite ban on explosives, made 220-ft sidehill cut to widen Pacific Highway near Woodland. Washington; 450,000 cu yd of unclassified material was removed.

SANITARY ENGINEERING

Malaria Control. Big Dividends from Malaria Campaign, P. J. Coffey. *Eng. News-Rec.*, vol. 135, no. 22, Nov. 29, 1945, pp. 722–725. Program of malaria control, including installation of permanent drainage facilities, resulted in 76% reduction of malaria incidence in City of Managua; main canal is 13,800 ft long, and uses 19 concrete drops 4 to 12 ft in height along course.

SEWERAGE AND SEWAGE DISPOSAL

Activated Sludge. Development of Activated Sludge Method of Sewage Treatment, S. A. Greeley. *Sewage Works J.*, vol. 17, no. 6, Nov. 1945, pp. 1135–1145. Development of attempts to accomplish satisfactory operation in preliminary treatment, aeration, final clarification, return of sludge, and disposal; principal steps in activated-sludge method; standard designs; loading yardsticks; departures from conventional design; application of method to various degrees of treatment; operating disturbances, routine and control; and results.

Activated Sludge. Operation of Activated Sludge Plants, G. P. Edwards. *Water Works & Sewerage*, vol. 92, no. 11, Nov. 1945, pp. 311–316. Theory of activated-sludge process, method of starting operation, variables in operation, method of sampling, disposal of excess activated sludge, degree of purification obtained by process, sludge bulking, rising sludge, and modifications of process are described.

Activated Sludge. Use of Digested Sludge and Digester Overflow to Control Bulking Activated Sludge, L. S. Kraus. *Sewage Works J.*, vol. 17, no. 6, Nov. 1945, pp. 1177–1190. Building activated sludge is controlled at Peoria, Ill., plant by application of digested sludge to activated sludge system; study of problem and conclusions.

Camps, Military. Comparison of Analyses of Composite Samples Collected over Eight, Sixteen and Twenty-Four Hours, A. D. Caster and R. C. Hamilton. *Sewage Works J.*, vol. 17, no. 6, Nov. 1945, pp. 1174–1176. Paper sets forth relationship between various sampling periods of raw sewage and effluents in military camps; comparison of results at Fort Knox, Ky.

Ordnance Plants, Sanitation. Water Supply and Sewage Works for Atomic Bomb City, G. E. Crosby and P. B. Streander. *Eng. News-Rec.*, vol. 135, no. 24, Dec. 13, 1945, pp. 819–822. How city's water supply developed from its tank wagon start to modern 15-mgd service, and how two complete sewage systems were built to handle flow from 75,000 population are described.

Oregon. Oregon Cities Plan Sewer Programs. J. W. Cunningham. *Western Construction News*, vol. 20, no. 11, Nov. 1945, pp. 96–97. Sewage plan of Portland for collecting all flow at single point, treating it, and discharging effluent into Columbia River; plans of other cities discussed.

Sedimentation. Rising of Activated Sludge in Final Settling Tanks, C. N. Sawyer and L. Bradney. *Sewage Works J.*, vol. 17, no. 6, Nov. 1945, pp. 1191–1209. Discussion of problem of rising or floating of activated sludge in final sedimentation tanks, based on investigations carried out at Sioux Falls, S.Dak., plant.

Sewage Filters, Trickling. Percolating Filter Scheme for Universal Operation, L. B. Escritt. *Surveyor*, vol. 104, no. 2809, Nov. 23, 1945, pp. 711–712 and 713. Description of plant suggested for scheme which allows variation in treatment and permits application of either alternating double filtration or recirculation.

Sludge. Operation of Sludge Drying and Sludge Gas Utilization Units, L. W. Van Kleeck. *Sewage Works J.*, vol. 17, no. 6, Nov. 1945, pp. 1240–1255. Conditioning of sludge prior to drying; processes for sludge drying; composition and amounts of sludge gas produced; collection of gas; uses for sludge gas.

Sludge Digestion. Scum-Free Sludge Digesters. *Am. City*, vol. 60, no. 11, Nov. 1945, pp. 100–101. One-mgd sewage treatment plant at Ludlow, Mass., avoids problem of scum in sludge digester by novel use of arrangement that jets hot supernatant into potential scum blanket, thus preventing its formation; certain other unique features of design simplify operation.

Treatment Plants, California. Postwar Sewage Disposal Projects in Northern California. C. G. Gillespie and E. A. Reinke. *Western City*, vol. 21, no. 11, Nov. 1945, pp. 54, 56, and 58. Survey of projects being planned. Before San Francisco Section, Am. Soc. Civ. Engrs.

Treatment Plants, Landscaping. 14,000 Plants Beautify Grounds at Sewage Works-Incinerator, W. Capwell. *Sewage Works Eng. & Mun. Sanitation*, vol. 16, no. 11, Nov. 1945. pp. 562–563. Digested sludge used as fertilizer for plants; attractiveness of garden has acted to break down prejudice of public toward visiting plant.

Treatment Plants, Maintenance and Repair. Concrete Resurfaced to Ward Off Acid Attack in Sewage Plants. *Works Eng. & Mun. Sanitation*, vol. 16, no. 11, Nov. 1945, pp. 558–561. Disintegration of concrete at sewage plants in Greenwich, Conn., is treated by resurfacing with gunite and applying acid-resisting coating; causes and extent of disintegration; setting up specifications for proper gunite job; account of work done; costs.

Water Pollution. Industrial Wastes and Fish Life, M. M. Ellis. Indus. Waste Utilization Conference—Proc. held at Purdue Univ., Nov. 29–30, 1944, pp. 126–134. Types of wastes that are hazardous to fish.

Water Pollution, Oregon. 1945 Progress Report on Pollution of Oregon Streams, F. Merryfield and W. G. Wilmot. *Oregon State College—Eng. Experiment Station—Bul. No. 19*, June 1945, 59 pp. 40 cents. Fundamentals of stream pollution are reviewed, methods used in sampling and analysis described, together with results and conclusions of study; methods of sewage and waste treatment for pollution abatement.

ONE METHOD

ISN'T THIS THE PRACTICAL ANSWER TO *Narrow Roads?*

Are any of the roads in your locality too narrow for safety under today's heavier, faster-moving traffic?

It's a simple matter to widen them with Tarvia* road tar or Tarvia-lithic.* Methods are quick and inexpensive. Combinations of Tarvia and aggregate are adaptable to any kind of road, any condition of shoulder areas.

Widening lengthens the life of the road, increases traffic capacity, eliminates hazardous drops between pavement and unfinished shoulder.

Thriving communities have a way of outgrowing their roads. Why not check yours? The Tarvia field man will be glad to work with you and specify proper shoulder foundations and wearing surfaces.

THE RESULT

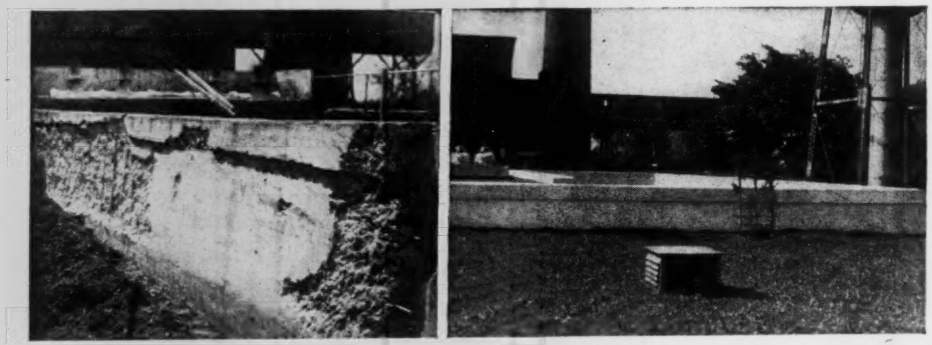
THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Barrett
Tarvia*
*Reg. U.S. Pat. Off.

New York · Chicago · Birmingham · St. Louis · Detroit · Philadelphia · Boston · Providence
Rochester · Minneapolis · Cleveland · Columbus · Toledo · Youngstown · Syracuse
Buffalo · Cincinnati · Bethlehem · Portland, Me. · Bangor, Me. · Oneonta, N. Y.
Norwood, N. Y. · Cromwell, Conn. · Norwich, Conn. · Savannah, Ga. · Norfolk, Va.
In Canada: The Barrett Company, Ltd., Montreal, Toronto, Winnipeg, Vancouver

ONE OF AMERICA'S GREAT BASIC BUSINESSES

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.



"GUNITE" SAVES COMPLETE REBUILDING

The above are "before" and "after" photographs of a sedimentation basin at the Water Works of the City of Batavia, New York, which we restored with "GUNITE" in 1944 under the direction of Mr. Fred F. Gordon, Consulting Engineer.

As shown on the left the original concrete walls of this basin were badly deteriorated. All disintegrated concrete was chipped out to solid surface and reinforcing mesh bolted in place. An average of more than two inches of "GUNITE" was placed on the inside and outside of the walls. Filter beds at the same plant were similarly restored.

Our 72-page bulletin B2300 describes this work and scores of other jobs where "GUNITE" has saved failing concrete structures of every description.

Write for bulletin B2300 today.

MANUFACTURERS OF THE "CEMENT GUN"

MOLYBDENUM STEELS

Experience proves that molybdenum steels meet the strictest service requirements, and meet them economically.

They are particularly noted for:

1. Excellent hardenability
2. Good low temperature impact
3. Good strength at elevated temperatures
4. Freedom from temper brittleness
5. Good machinability in the heat treated condition.

Detailed information on the different types of molybdenum steels is given in our technical book "Molybdenum in Steel". The book will be sent free to interested engineers and metallurgists.

CLIMAX MOLYBDENUM CO.
500 FIFTH AVENUE · NEW YORK 18, N. Y.

STRUCTURAL ENGINEERING

BEAMS AND GIRDERS, WOODEN. Tests on Creosoted Laminated Stringers, O. H. Schrader, Jr. *Eng. News-Rec.*, vol. 135, no. 20, Nov. 15, 1945, pp. 650–653. Report of tests made to determine effect of pressure creosoting on cured phenolic glue line and strength characteristics of creosoted, laminated, railroad bridge timbers.

BRIDGE DESIGN. Three-Span Flat Slab Bridges, A. W. Hill. Surveyor, vol. 104, no. 2806, Nov. 2, 1945, pp. 651–653. Simplified procedure for design of bridge with three equal spans.

BRIDGE DESIGN. Three-Span Flat Slab Bridges—II, A. W. Hill. *Surveyor*, vol. 104, no. 2809, Nov. 23, 1945, pp. 719–720. Design of three-span bridge where two end spans are equal.

COLUMNS, STRESSES. Column Stress by Successive Deflections, L. T. Wyly. *Eng. News-Rec.*, vol. 135, no. 20, Nov. 15, 1945, pp. 660–663. Factors controlling stability of column subjected to direct stress and bending are more clearly visualized through graphic and analytical studies based on successive deflections; percentage of probable error for short columns is shown to be insignificantly small regardless of assumed shape of elastic line during bending.

TUNNELS

RAILROAD TRACKS, RELOCATION. Plan Realignment of "Sierra Hump." *Western Construction News*, vol. 20, no. 11, Nov. 1945, pp. 102–105. Construction of 57-miles of tunnel and electrification included in plan for section of Southern Pacific Railroad; annual reduction of $7,667,100 in direct operating cost will amortize project cost in 27 years.

WATER PIPE LINES

AQUEDUCTS, UTAH. Salt Lake Aqueduct—Built with Six-Foot Concrete Pipe. *Western Construction News*, vol. 20, no. 11, Nov. 1945, pp. 110–114. 41-mile system will assure Utah's capital city ample water supply of 150 cu ft per sec; pre-cast concrete pipe has bell and spigot-type joint sealed with rubber gasket and subjected to maximum of 150-ft hydraulic head; tests run on 9-mile section in 1941 showed water loss of only 235 gal per mile per 24 hr.

WATER RESOURCES

ERITREA. Water Supply in Eritrea, H. L Holloway. *Water & Water Eng.*, vol. 48, no. 595, Nov. 1945, pp. 599–608. Improvements effected by British administration.

WATER SUPPLY, CALIFORNIA. Santa Barbara County Water Agency to Serve Cities and Districts, L. Swanson. *Western City*, vol. 21, no. 11, Nov. 1945, pp. 30–31. Water-storage and flood-control program for central coast district planned.

WATER TREATMENT

INDUSTRIAL. 1944 Water Conference. *Corrosion & Material Protection*, vol. 2, no. 5, Aug. 1945, pp. 25–28. Abstract of proceedings of 1944 Water Conference of Engineers Soc. of Western Pennsylvania, dealing with water corrosion and treatments for its prevention; subjects discussed include de-alkilization, demineralization, de-ammonification, cathodic protection of submerged structures, industrial water treatment, scale formation in cooling water, waste pickle liquor, and silicates in coagulation.

RESERVOIRS, INSECT CONTROL. Predaceous Diving Beetles in Winnipeg's Water Supply, W. D. Hurst. *Am. Water Works Assn.—J.*, vol. 47, no. 11, Nov. 1945, pp. 1204–1206. Steps taken to overcome problem of beetles found in and around reservoirs of city water supply system; report on successful use of chemicals to clean reservoirs and overcome troubles.

SEA WATER SALT REMOVAL. Drinking Water from Sea Water. *Chem. Age*, vol. 53, no. 1376. Nov. 10, 1945, pp. 437–439. Work of Royal Naval Scientific Service with reference to rendering sea water potable; apparatus consists of flexible purifier made of rubberized fabric, 9 chemical charges enclosed in rubberized fabric storage bag to keep them dry during storage and use of apparatus, and Perspex drinking box into, which rest of equipment is packed; each chemical charge will produce 1/2 pint of drinking water from sea water so that apparatus will produce 4 1/2 pints of drinking water.

WATER WORKS ENGINEERING

ALBERTA. Water Supply Problems in Alberta, Canada, D. B. Menzies. *Am. Water Works Assn.—J.*, vol. 38, no. 2, Feb. 1946, pp. 227–233. Geological and other conditions of province of Alberta, Canada, in connection with water supply; main problems encountered are difficulty in getting water of good chemical quality and in sufficient quantity from wells, high cost of pipes, chemicals, etc., due to westerly location of province, hardness and difficulty of removing color from surface waters, and external corrosion of metal pipes.

WATER TANKS AND TOWERS, STEEL. Two New Tanks in Water Distribution System Serving Two Indiana Towns. *Water Tower*, vol. 32, no. 3, Jan. 1946, p. 4. Illustrated description of two conispherical elevated tanks for 250,000 and 150,000 gal, respectively, of water works system serving Warsaw, Ind., and Winona Lake, Ind.; data on technical details and improved pressure conditions presented.